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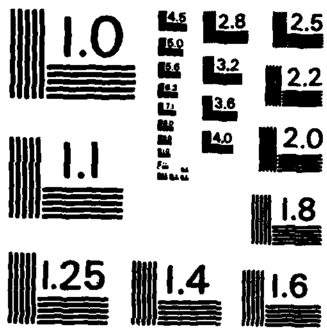

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TECHNICAL REPORT

A CUMULONIMBUS AND THUNDERSTORM STEPWISE MULTIPLE REGRESSION OBJECTIVE FORECAST STUDY FOR SALT LAKE CITY

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Meteorological Branch
Test Design and Analysis Division
Materiel Test Directorate

U.S. ARMY DUGWAY PROVING GROUND

DUGWAY, UTAH 84022-5000

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The University of California BMDP2R Stepwise Multiple Regression program was used to obtain prediction equations for cumulonimbus or precipitation and for thunder at the Salt Lake City airport weather station. Fourteen years of data for the five months May through September were analyzed. The data were broken into two time periods; the spring and fall months May-June 14 and September and the summer months June 15 to August 31. The Observed 12Z Salt Lake City radiosonde (RAOB) was used to forecast the probability of occurence

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of cumulonimbus or thunder from RAOB time to 2400 MST (0700Z). The five year independent data 12Z RAOB skill scores for cumulonimbus were 0.62 for spring and fall and 0.50 for the summer months. The 12Z RAOB thunder equation independent data skill scores were 0.26 for spring and fall and 0.36 for the summer months.

Tables are presented to assist the forecaster in determining the probability of occurence of cumulonimbus or thunder for the various regression equations and for single predictors. High and low probability forecasts can be used to improve the forecast confidence.

Single predictors such as the average relative humidity from the surface to 400 millibars for cumulonimbus or lifting index or precipitable water for thunder can be used to obtain skill scores slightly smaller than those of the best equations.

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SECTION I. INVESTIGATION

1. BACKGROUND. Heavy rain, lightning or strong, variable winds caused by thunderstorms can adversely affect Dugway test operations. In 1968, there was a review of Dugway test operations by the Stewart Committee (Reference 1). The Committee recommended that "no thunderstorms shall be present within 100 miles of test site at agent release time or predicted to occur within 100 miles of the cloud trajectory for at least eight hours from the release time. Confidence in the weather forecast shall be high. There must be (documented) past experience demonstrating the reliability of predictions from similar weather situations." The committee further recommended that "a climatology of favorable testing periods based on various weather restrictions be prepared." The Committee pointed out that "the responsibility for meteorological research and development .... was assigned to Dugway Proving Ground in 1953." It recommended that "a program to improve forecasting capability should be implemented ..... Experience elsewhere (in 1968) indicates that, in general, the forecasting capability leaves much to be desired. Such research (at Dugway) may eliminate some of the weather restrictions..."

Safety hazards arising from the release of lethal chemical agents are not a factor in the present Dugway test program. Creating an efficient, economical test program for aerosols other than such chemical agents is still a goal. For this purpose, the recommendations designed to improve weather forecasts made by the Stewart Committee are still valid.

Since 1968, there has been a rapid improvement in the ability of the National Weather Service (NWS) to gather and analyze meteorological data. The Geostationary Environmental Operating System (GOES) (Reference 2) used to track the movement of large weather systems through satellite imagery became operational in 1971. In 1972, Glahn and Lowry (Reference 3) introduced a statistical method for forecasting maximum and minimum temperatures and rainfall amounts for the entire U.S. These forecasts are known as model output statistics (MOS). The Automatic Field Operating System (AFOS) (Reference 4) was introduced in 1978 to make computer analyzed meteorological products and modern data transmission techniques available at the local level. The AFOS system uses mini-computers to present mesoscale analyses and forecasts and simplified 12-hour synoptic map forecasts. Numerical forecasting improves with the speed of computers. In 1979, Reap and Foster (Reference 5) completed an objective study of thunderstorm forecasting for the area east of the Rocky Mountains. Thunderstorm forecasts based on this study are made available to local forecasters on a daily basis. The NWS currently uses a super computer for developing weather predictions that is ten times faster than computers available in 1968. The seven layer limited area fine mesh (LFM) weather prediction model currently used by the NWS is being compared to a new sixteen layer nested grid primitive equation model (NGM). The Numerical Modelling Center (NMC) is also experimenting with preparing specialized regional forecasts for four U.S. regions (Reference 6). GOES imagery can be interpreted to detect the presence of thunder clouds (cumulonimbus) (Reference 2). A program will be initiated to maximize the Dugway forecasters' ability to interpret the GOES transmissions for that purpose.

Automatic Lightning Detection System (ALDS) (Reference 7) hardware for

detecting cloud-to-ground lightning discharges has also become available and the U.S. Bureau of Land Management operates the system in the western states during the summer thunderstorm season. U.S. Army Dugway Proving Ground (DPG), under the DPG Modernization Plan, is in the process of acquiring the instrumentation and services that will make these improved meteorological products available to DPG meteorologists. Even though advanced methods developed since 1968 will be available to DPG, the problem of detecting and tracking thunderstorm activity (as evidenced by imagery, precipitation detection, etc.) has not been overcome. For example a 1975 NWS Western Region paper (Reference 8) presents a regional map showing that the Western Region radar net detects precipitation at Dugway on a 60 percent probability basis. Precipitation detection confidence west of Dugway is only 40 percent. In 1975, the nearest WSR-57 radar was at Limon, Colorado. The others in Utah, Wyoming, Idaho, Nevada, Arizona, and New Mexico were all FAA ARTC radars (Reference 9). ARTC radar is less sensitive than the standard WSR-57 equipment. The gain of The FAA radar has to be turned down when airborne planes are in the vicinity. This results in a reduction in the ability to detect precipitation. There have been two changes since 1975. New WSR-57 radars have been installed at Las Vegas, Nev. and Cheyenne, Wyo., both about 360 miles from Dugway. The NWS still finds it necessary to use a statistical study to forecast severe weather caused by thunderstorms east of the Rocky Mountains (Reference 5). No regional studies are available for the area west of the Rocky mountains. This paper is designed to partially fill the thunderstorm forecasting knowledge gap as it affects Dugway operations. Anthes (Reference 10) points out that quantitative prediction of convective clouds from a mesoscale model is expensive and not competitive with the statistical forecasts provided by the NWS (Reference 5).

There are a number of objective forecast studies in existence. One type uses specialized initial conditions on a limited sample in order to apply known physical principles (Reference 11). Another popular study technique uses a system of successive elimination (Reference 12). A third type uses multiple regression analysis. The NWS study (Reference 5) is of this type. It further combines climatic probability to forecast thunderstorm probabilities of occurence for the area east of the Rocky Mountains. A study by Randerson (Reference 13) uses discriminant analysis to predict cumulonimbus (CB) at the Las Vegas, Nevada Test Site (NTS) for the period June through September.

2. OBJECTIVES. The initial goal of this effort was to use four years of Salt Lake City (SLC) radiosonde and surface observation data to produce a CB forecast by the successive elimination technique. As the study progressed the goal became the development of both CB and thunder probability forecasts based on a multiple regression analysis of nine years of dependent data to be checked using five years of independent data. The forecast period used in the study is the 18 hour period from 0600 to 2400 Mountain Standard Time (MST). To simplify the use of this study, all the techniques were developed to be implemented by computer analysis of the observed morning SLC radiosonde for 1200 Greenwich Mean Time (12Z or 0500 MST) or the forecast afternoon radiosonde for 0000 Greenwich Mean Time (00Z or 1700 MST).

3. DETAILS OF THE FORM OF DATA AVAILABLE. To begin this study, SLC upper air observations of winds, temperature, dewpoint depression and height were obtained from copies of the SLC radiosonde transmission kept on file at the SLC

airport station. Four years (1980-83) of radiosonde and surface observation data for the months May through September were obtained in this manner. It became evident as the study progressed that the sample size was too small and ten additional years (1970-79) of SLC radiosonde and surface data were added to the initial four.

4. ANALYSIS AND RESULTS.

a. Climatology. Three-hourly observations of CB and thunder (TSTM) were used to illustrate the relative frequency of occurence by time of day for the months May, July, August, and September (Table 1). The primary hours of test operation at Dugway are between 0500 and 2400 MST. It can be seen from Table 1 that most of the thunder observed at the SLC airport occurs during the period from 0800 to 0200 MST on the following morning. The frequency distribution of CB observed at Dugway is similar to that at SLC. During July and August, Dugway thunder tends to occur most often between 1730 and 2000 MST, with a peak frequency of occurence a little later than at SLC. The DPG frequency of thunder occurence may also be higher than at SLC during the peak period of thunderstorm activity.

Table 1. Frequency of Occurence of Cumulonimbus and Thunder by Time of Day for the Years 1970-78 at the Salt Lake City Airport Weather Station.

Time MST	2	5	8	11	14	17	20	23
Cumulonimbus Frequency in Percent								
May	7.9	9.0	11.5	17.6	29.4	31.5	20.4	10.4
July	8.6	7.5	6.5	10.8	28.0	31.5	26.2	14.3
August	11.1	9.7	5.7	7.9	25.8	21.9	20.1	12.9
September	6.3	7.8	8.5	8.9	14.8	17.0	12.2	5.2
Thunder Frequency in Percent								
May	1.8	0.0	0.0	2.9	6.8	6.8	4.3	1.8
July	1.4	1.4	1.4	3.6	9.0	10.0	8.6	6.1
August	3.9	3.2	1.8	2.9	7.9	7.9	6.5	2.2
September	3.3	2.2	1.5	1.1	5.6	5.9	4.1	2.6

b. Preliminary Analysis. A study of the four years of manually reduced data was used to choose the predictand. A CB coverage of 0.2 was chosen as one predictand. It appears that less than 0.2 coverage of CB clouds is difficult to forecast. Also the skill level improves slightly if the predictand includes the observation of CB or precipitation (CBPRE) during the verifying period. SLC three-hourly surface observations were used to determine the presence of 0.2 CB or more. The start and stop times of all precipitation and of thunder heard at the station are included on the surface observation form as well as in the data transcribed for this study.

c. Choice of Predictors. The predictors chosen are those often selected for

thunderstorm or CB forecast studies (Reference 5). The method of calculating most of the variables used as predictors is given in a White Sands publication (Reference 14). Some calculations were made with the help of programs supplied by Scientific Services, Western Region, NWS. The final program for extracting the predictors from the SLC radiosonde data was prepared by Computer Data Systems, Inc. (CDSI) under Contract No. K008302C 2691 with DPG. This program, written in FORTRAN 77, is reproduced in Appendix F. User-friendly menus for other programs used for the data analysis appear in Appendix G. An alphabetical list of the predictors appears in Table 2. A list of all the variables in the order they appear in the computer program output file is given in Appendix E.

It was not practical to use predictors requiring the use of synoptic map data. Examples of these predictors are vorticity advection, temperature advection, moisture divergence, or calculations of vertical motion.

The often used K stability index (Reference 15) given by

$$K = (T85 - T50) + TD85 - (T70 - TD70) \tag{1}$$

was selected for this study. The symbolic notation for the variables in equation (1) and the following equations is defined in Table 2. The larger the value of K, the greater is the occurence probability of CB or TSTM.

The Total Totals (TOT) index (Reference 16) had to be modified for application at the 1288 m above sea level elevation of the SLC weather station. The form used here is

$$TOT = T70 + TD70 - 2T50 \tag{2}$$

Again, the larger the value of TOT, the greater is the probability of convective cloud activity which may lead to thunderstorm development.

Convective instability (CONVI) is given by the lapse rate of equivalent potential temperature (EQPT) and is computed from

$$CONVI = EQPT50 - (EQPT85 + EQPT70) \tag{3}$$

The lifting index stability parameter used by the NWS (LINWS) is obtained by first finding the average mixing ratio in the lowest 150 mb. Next the dry adiabat is followed up from the surface temperature to the intersection with the average mixing ratio line on the SKEW-T diagram. The moist adiabat is then followed up until it intersects the 500 mb level. The temperature at that point is subtracted from the measured temperature at 500 mb and the temperature difference defined as the LINWS. A simpler form of lifting index (LIW) can be calculated by using the mixing ratio line through the surface dew point and following the dry adiabat through the surface temperature to intersection with the chosen mixing ratio line. The procedure from the intersection point up is the same as for the calculation of LINWS. The smaller the value of LIW or LINWS, the greater the instability.

Positive area (POSAR) is a third vertical instability indicator and is calculated by following the mixing ratio line through the surface dewpoint on the

Skew-T diagram up to the intersection with the temperature sounding. The moist adiabat is then traced aloft to the point where it intersects the sounding the second time. The area between the moist adiabat and the sounding is the

Table 2. List of the Predictors Used in the Screening Regression Procedure.

Predictor and Abbreviation Used in Text
Convective instability (CONVI), ^{o}C, defined in text
Dewpoint (surface (SURTD), 850 mb (TD85), 700 mb (TD70), 500 mb (TD50) and 400 mb (TD40)), ^{o}C.
Dewpoint depression for the same levels, (SURDEP), (DEP85), etc., ^{o}C.
Height (850 mb (H85), 700 mb (H70), 500 mb (H50)), m
K index, (K), equation (1)
Lifting index starting with the surface temperature and mixing ratio (LIW) and starting with the mean mixing ratio in the lowest 150 mb (LINWS), defined in text
Positive area (POSAR), joules/gm, defined in text
Precipitable water from surface to 500 mb (PW), inches
Pressure at the surface (SURP), mb
Relative humidity averaged from surface to 500 mb (RH5) and from surface to 400 mb (RH4), percent
Stability indices, UI (equation (4)) and UII, defined in text
Temperature (Surface (TSUR), 850 mb (T85), 700 mb (T70), 500 mb (T50), 400 mb (T40)), ^{o}C
Thickness from 850 to 700 mb, (H7085), m
Total totals (TOT), equation (2), ^{o}C
Wind speed components, surface and 850 mb average (USUR) and (VSUR), 700 mb (U7) and (V7), 500 mb (U5) and (V5), where westerly and southerly components are positive, easterly and northerly negative, knots

positive area. The larger the positive area, the greater the instability and chance of CB activity. POSAR, LIW, LINWS, and CONVI were all calculated using programs supplied by Scientific Services, Western Region. Graphical techniques can be used to calculate the above parameters but the process is slow. To obtain

the positive area graphically, the number of squares included in the area must be counted. If there is no positive area, POSAR is set equal to zero.

The upper level stability index (UI) is a predictor used to forecast high-level thunderstorms (Reference 17) in the Western Region, NWS. To obtain this parameter follow the dry adiabat through the 500 mb temperature aloft until the parcel becomes saturated. From that point, which is the lifting condensation level (LCL), follow the moist adiabat to the 400 mb and 300 mb levels. The temperatures of the parcel at 400 and 300 mb are referred to as T(4) parcel and T(3) parcel. Then

$$UI = (T40 - T(4)\ \text{parcel}) + (T30 - T(3)\ \text{parcel}) \qquad (4)$$

This index is combined with the 700 mb dewpoint depression to get the final stability index (UII). The method of calculating UII (Reference 18) was modified for this study and is

If DEP70 > 25 and UI < 2, UII = 7
If UII not > 6, DEP70 > 20 AND UI < 3, UII = 6
If UII not > 5, DEP70 > 15 AND UI < 4, UII = 5
If UII not > 4, DEP70 > 10 and UI < 5, UII = 4
If UII not > 3, DEP70 > 5 and UI < 6, UII = 3
If UII not > 2, DEP70 > 0 and UI < 7, UII = 2
If UI > 7, UII = 1

The predictor UII is commonly used to forecast high winds at Dugway. In late spring and early summer, a UII of six or more is associated with a high probability of strong surface winds.

d. Choice of the Predictand and the Verification Period. The relatively frequent occurence of CB at SLC (or DPG) and the association of these clouds with the possibility of strong gusty surface winds suggested that CB could be objectively forecast and that an improvement in such forecasts would be operationally useful. The 12Z SLC radiosonde (RAOB) is available for morning briefings at Dugway. Field tests may be conducted during the time period from 0800 to 2400 MST. For this reason, the first verification period of 0600 to 2400 MST was chosen. The choice of 0.2 CB or more observed on at least one SLC three hourly surface observation during the verification period as a predictand was based on the apparent lack of sensitivity of the predictors to less than 0.2 CB. The addition of rain (PRECI) defined as a trace or more was made because predicting rain is part of the DPG forecast problem and because the combination CB or PRECI (CBPRE) slightly improved the model performance. The choice of a second verification period of 1200 to 2400 MST was made to determine whether or not use of the 00Z RAOB data improved performance. Most convective activity occurs in the afternoon. If use of the observed 00Z RAOB data was found to improve performance, plans were to use NMC prognostic maps to derive a forecast 00Z RAOB from which the forecast stability predictors could be determined.

Thunder (TSTM) forecasting is much more difficult than the CBPRE forecast problem. The frequency of occurence of thunder heard at SLC is small. A high percent of correct forecasts can be obtained by forecasting no thunder heard at

the station for all verification time periods. The estimated maximum distance that thunder can be heard is 15 km (Reference 19). The horizon involved in the observation of CB may extend to a distance of 48 km. All of a two tenths sky coverage could be well beyond the 15 km limit indicated for hearing thunder. The intense vertical convection associated with the formation of a thunderstorm is very local, but the general condition consistent with such formation might be adequately measured by the RAOB when the actual occurence is beyond hearing range.

Five possible predictands were included in the computer data files used to prepare the objective analysis. They were CB, PRECI, CBPRE, TSTM, and thunder and precipitation occuring at the same time (TSPRE). Due to time limitations, only the CBPRE and the TSTM predictands were analyzed in this study.

e. Stepwise Multiple Regression Screening Technique. A common means of ranking predictors is by the percent reduction of variance explained by each. Neter and Wasserman (Reference 20) point out that, when more than one predictor is involved, the percent of reduction of variance is not the same as when each is considered alone. A high correlation between predictors in an equation indicates there may be too many independent variables. Use of the UCLA BMDP stepwise regression program 2R (Reference 21) makes it possible to choose the best predictors, determine the reduction of variance of each, observe the correlation between predictors, and produce an equation designed to forecast the predictand. An occurence in the data file of a predictand for the observation period is indicated by "1". A non-occurence is indicated by "0". The equations obtained by the regression analysis technique predict some value between zero and one (actually from a little less than zero to a little more than one).

The following text will discuss various regression equations by number. The best of these equations have been included in Appendix D. When referred to in the text, the form will be equation 3, etc. Numbered text equations will be referred to as equation (3), etc.

The first data processed using the BMDP2R program were the years 1980-83 and included the months May-September, the primary TSTM season. The program can analyze only 9999 points at a time. At first 27 predictors were screened. Hence, not more than 370 cases could be treated at one time. There were 599 cases in this total data sample for the 12Z SLC RAOB. The sample was cut in half and two runs made. The best 16 predictors were then analyzed for the whole sample and the first CBPRE equation calculated (equation 3). The resultant multiple correlation was 0.61 (a reduction in variance of 37.2 percent). The first predictor chosen was TOT. A similar procedure was followed to obtain an equation using the 00Z (1700 MST) RAOB. The best equations were numbers 10 and 11. The first predictors chosen were RH5 and LIW for equation 10 and RH4 and LINWS for equation 11. For both equations the correlation was 0.69 (a reduction in variance of 47.6 percent). These results imply that the 00Z RAOB equation for the five month period is significantly more powerful than the 12Z equation for the same time period. Eight more predictors were added to the list for a total of 35. A 12Z RAOB screening technique similar to that used to get equation 3 produced equation 16. The first variable chosen was RH4. The equation correlation was 0.64 (a reduction

in variance of 41.0 percent).

The next test was to determine whether there is an appreciable difference between the summer months July and August and the spring and fall months May and September. July and August 1980-83 were analyzed for the 00Z RAOB data to produce equation 12. The first predictor chosen was RH4. The equation multiple correlation was 0.66 (a reduction in variance of 43.6 percent). May and September were then analyzed together using the 00Z radiosonde to produce equation 13. The first predictor chosen was RH4. The equation multiple correlation was 0.77 (a reduction in variance of 59.3 percent).

The above treatment resulted in four best equations for 1980-83. The 12Z equations were 3 and 16. The 00Z equations were 10 and 11. For both times the first equation included RH5, the second RH4. These results were controlled. The regression model was offered either RH5 and LIW or RH4 and LINWS but never both pairs at the same time. The above results indicate that 00Z RAOB equations are more powerful than 12Z equations and that a CBPRE spring-fall 00Z equation is better than a summer 00Z equation. Later tests will be used to determine which are the best equations.

As a result of the better multiple correlation obtained above for the May and September equation 13 ($r = 0.77$) compared to the July and August equation 12 ($r = 0.66$), it was decided to divide the thunderstorm season into two periods when specific predictors may dominate. One period was chosen to represent summer months when convective systems dominate and extended from June 15 to August 31 (JJA). The other period was limited to the spring and fall months when frontal passages tend to be more frequent. This second period included May to June 14 and September (MJS). Analysis of MJS 12Z data produced two CBPRE equations. The first was equation 30 (Appendix D) for which the whole sample was used. The first two predictors chosen by equation 30 were LINWS and RH4. The equation correlation was 0.67 (a reduction in variance of 44.9 percent). The second was equation 31 where the data analyzed were screened so that during September, the occurences and non-occurences were equal. This reduced the sample size by 18 percent. The first predictors chosen by equation 31 were LINWS and RH4. The equation correlation was 0.61 (a reduction in variance of 37.2 percent). The 00Z radiosonde MJS equations obtained for 1970-78 were 32 and 34. The first predictors chosen for equation 32 were RH4 and LINWS. The equation multiple correlation was 0.74 (a reduction in variance of 54.8 percent). The 00Z RAOB MJS equation 34 sample size was cut 19.5 percent in the same manner as for 31 above. The first predictors chosen were RH4 and LINWS. The equation multiple correlation was 0.72 (a reduction in variance of 51.8 percent). The JJA CBPRE equations for 1970-78 are 27 for 12Z and 33 for 00Z. The first two variables chosen by the regression analysis for equation 27 were RH4 and SURT. The equation correlation was 0.66 (a reduction in variance of 43.6 percent). The first two predictors chosen for equation 33 were RH4 and LINWS. The equation correlation was 0.69 (a reduction in variance of 47.6 percent).

The above analysis represents the use of three different dependent data periods to obtain the equations; May through September 1980-83, May-June 14 and September 1970-78 and June 15-August 31 1970-78. The best two equations for MJS and JJA 12Z and 00Z were then chosen. For MJS the equations were 30 and 31

reduction in variance was 21.2. The basis of a yes forecast was an R value of 0.6 or more. The 1970-78 data skill score was 0.34. The independent data skill scores were 0.33 for 1979-81 and 0.19 for 1982-83. The equation 44 percent

Table 15. Equations 37 and 44 12Z Radiosonde Thunder Objective Forecast Statistics for May 1 to June 14 and September.

	Equation 37 Frequencies of Occurence by R Class					(6) Man Smooth	(7) % of Total
Years	(1) 70-78	(2) 79-81	(3) 82-83	(4) 79-83	(5) 70-83	70-83	70-83
R							
< 0.1	0.011	0.000	0.054	0.033	0.020	0.027	14.6
0.1-0.3	0.027	0.086	0.147	0.109	0.058	0.059	23.8
0.3-0.5	0.105	0.160	0.129	0.151	0.122	0.117	29.2
0.5-0.7	0.279	0.343	0.222	0.290	0.282	0.290	20.0
0.7-0.9	0.456	0.267	0.462	0.357	0.427	0.418	9.5
≥ 0.9	0.375	0.500	0.400	0.462	0.414	0.420	2.9
Column (1)		& (2)	& (3)	& (4)		(5)&(6)	
r		0.824	0.957	0.935		0.999	
E.E.(3)		0.364	0.137	0.186		0.022	
E.E.(4)		0.377	0.157	0.241		0.028	
E.E.(5)		0.576	0.707	0.581		0.026	
% Corr	79.5	79.9	74.1	77.6	78.1		
S.S.	0.34	0.33	0.19	0.27	0.31		
No Occ	101	37	25	62	163		
Total No	651	214	147	361	1012		

	Equation 44 Frequencies of Occurence by R Class					(6) Man Smooth	(7) % of Total
Years	(1) 70-78	(2) 79-81	(3) 82-83	(4) 79-83	(5) 70-83	70-83	70-83
R							
< 0.1	0.015	0.025	0.063	0.039	0.023	0.023	38.4
0.1-0.3	0.132	0.171	0.140	0.157	0.140	0.140	38.0
0.3-0.5	0.461	0.311	0.306	0.309	0.398	0.398	19.4
0.5-0.7	0.556	0.500	0.500	0.500	0.524	0.524	4.2
0.7-0.9	0.000	0.000	0.000	0.000	0.000	0.000	0.0
≥ 0.9	0.000	0.000	0.000	0.000	0.000	0.000	0.0
Column (1)		& (2)	& (3)	& (4)		(5)&(6)	
r		0.920	0.964	0.972		1.000	
E.E.(3)		0.276	0.244	0.256		0.009	
E.E.(4)		0.330	0.651	0.497		0.017	
E.E.(5)		-	-	-		0.018	
% Corr	87.6	75.7	75.5	75.6	82.9		
S.S.	0.49	0.25	0.27	0.26	0.39		

The JJA CBPRE results are summarized in Table 14.

Table 14. June 15-August 31 Cumulonimbus or Precipitation Forecast Equations Performance.

Years	1970-78		1979-81		1982-83		1970-83		1979-81		1982-83	
Eqn	S.S.	% Corr	S.S.	% Corr	S.S.	% Corr	S.S.	% Corr	Eight E.E.	Case B.S.S.	Eight E.E.	Case B.S.S.
JJA 12Z Radiosonde Equations												
27	0.62	81.1	0.52	76.7	0.42	71.8	0.58	78.9	0.29	0.016	0.26	0.015
16	0.56	78.2	0.47	74.0	0.46	73.8	0.53	76.7	0.25	0.015	0.29	0.016
JJA 00Z Radiosonde Equations												
33	0.65	83.3	0.63	82.0	0.63	81.1	0.64	82.7	0.13	0.008	0.49	0.028
11	0.60	81.4	0.61	81.6	0.64	81.8	0.61	81.5	0.15	0.011	0.21	0.015

i. The Basis of Choosing a Dependent Data Sample for Thunder. During the 12Z MJS period, thunder occured on 16 percent of the days. During the JJA 12Z period, it occured on 19 percent of the days. The contingency table skill score method produces results which can be reliably compared if the sample consists of 50 percent occurences and 50 percent non-occurences. It was decided to produce screened samples in which thunder occured 50 percent of the time. The equations found using this method overforecast thunder on the larger unscreened sample. It was found that skill score was optimized for equations formulated using a 50-50 screened sample if yes was forecast on the whole unscreened data sample only for equation values of 0.6 or more. A second analysis of the data was made using the whole dependent data sample (1970-78). Equations resulting from this treatment produced a maximum skill score if yes was forecast for equation values of 0.35 or more. Results from the two approaches were similar. The best equation of each type is discussed in the following paragraphs.

The same grouping of months used above for the cumulonimbus study and the same method of comparing results was used for the thunder study. Because of the irregularity of results, the R class sizes were made larger in order to obtain increasing values of probability with increasing equation R values. This was accomplished by changing the class increments from one tenth R values to two tenths. The same BMDP2R program and the same independent variables were used to obtain the equations.

j. Evaluation of the MJS Thunder (TSTM) Equation Results. In the following discussion, the equations will be treated in pairs. The first equation of a pair was formulated using a 50-50 screened sample, the second using the whole data sample. The best 12Z RAOB TSTM equations for MJS were 37 and 44. The best 00Z RAOB equations were 21 and 45. Performance results for these equations appear in Tables 15 and 16. For equation 37, the percent

Table 13. Equation 11 00Z Radiosonde Cumulonimbus or Precipitation Objective Forecast Statistics for June 15 to August 31.

	Frequencies of Occurence by R Class					(6)	(7)
	(1)	(2)	(3)	(4)	(5)	Man Smooth	% of Total
Years	70-78	79-81	82-83	79-83	70-83	70-83	70-83
R							
-0.111	0.000	0.038	0.000	0.030	0.008	0.008	11.4
0.05	0.040	0.042	0.000	0.031	0.037	0.055	10.1
0.15	0.057	0.154	0.100	0.139	0.081	0.123	11.7
0.25	0.325	0.136	0.000	0.081	0.248	0.200	11.0
0.35	0.356	0.306	0.235	0.283	0.329	0.350	13.2
0.45	0.569	0.688	0.444	0.600	0.578	0.578	7.8
0.55	0.781	0.741	0.583	0.692	0.748	0.700	9.7
0.65	0.765	0.917	0.667	0.758	0.762	0.800	7.9
0.75	0.909	0.778	0.846	0.818	0.873	0.873	5.2
0.85	0.926	1.000	0.923	0.960	0.942	0.922	4.9
0.95	1.000	0.857	0.889	0.875	0.938	0.950	3.0
1.123	1.000	1.000	0.889	0.950	0.978	0.978	4.3
Columns	(1)	& (2)	& (3)	& (4)		(5)&(6)	
r		0.961	0.968	0.975		0.997	
E.E.(8)		0.151	0.213	0.113		0.037	
E.E.(9)		0.308	0.696	0.415		0.080	
E.E.(10)		0.412	0.683	0.474		0.151	
Percent Correct	81.4	81.6	81.8	81.7	81.5		
Skill Score	0.60	0.61	0.64	0.63	0.61		
Number of Occ	284	98	69	167	451		
Total No	693	228	143	451	1064		

Table 12. Equation 33 00Z Radiosonde Cumulonimbus or Precipitation Objective Forecast Statistics for June 15 to August 31.

Years	Frequencies of Occurence by R Class (1) 70-78	(2) 79-81	(3) 82-83	(4) 79-83	(5) 70-83	(6) Man. Smooth 70-83	(7) % of Total 70-83
R							
-0.099	0.000	0.000	0.000	0.000	0.000	0.000	8.8
0.05	0.018	0.000	0.000	0.000	0.013	0.020	7.4
0.15	0.012	0.129	0.000	0.108	0.042	0.055	11.2
0.25	0.213	0.150	0.063	0.111	0.181	0.181	10.9
0.35	0.302	0.265	0.083	0.217	0.273	0.275	12.4
0.45	0.458	0.368	0.250	0.333	0.424	0.424	9.3
0.55	0.653	0.571	0.471	0.526	0.598	0.598	8.2
0.65	0.833	0.833	0.692	0.774	0.810	0.740	7.4
0.75	0.783	0.824	0.545	0.714	0.757	0.840	7.0
0.85	0.946	0.750	0.929	0.864	0.915	0.915	5.5
0.95	0.958	1.000	0.889	0.950	0.955	0.955	4.1
1.187	1.000	0.944	0.875	0.905	0.951	0.955	7.7
Columns	(1)	& (2)	& (3)	& (4)		(5)&(6)	
r		0.980	0.975	0.988		0.996	
S.E.(8)		0.134	0.491	0.189		0.049	
S.E.(9)		0.171	0.588	0.276		0.046	
S.E.(10)		-	-	-		0.095	
Percent Correct	83.3	82.0	81.1	81.7	82.7		
Skill Score	0.65	0.63	0.63	0.63	0.64		
Number of Occ.	284	98	69	167	451		
Total No.	693	228	143	371	1064		

well on the 1970-78 JJA 00Z data. The percent reduction in variance on the dependent data years was 46.1. The skill scores on the JJA data were 0.60, 0.61 and 0.64, respectively for 1970-78, 1979-81, and 1982-83. Again, the difficulties found for the 12Z RAOB do not arise for this 00Z RAOB equation. Equation 11 also cannot be used to forecast probabilities better than 90 percent. None of the R ranges in Table 13 are associated with zero probabilities for all of the time periods.

Table 11. Equation 16 12Z Radiosonde Cumulonimbus or Precipitation Objective Forecast Statistics for June 15 to August 31.

	Frequencies of Occurence by R Class					(6) Man Smooth	(7) % of Total
Years	(1) 70-78	(2) 79-81	(3) 82-83	(4) 79-83	(5) 70-83	70-83	70-83
R							
-0.071	0.000	0.000	0.000	0.000	0.000	0.000	2.1
0.05	0.000	0.063	0.200	0.095	0.041	0.038	4.6
0.15	0.057	0.069	0.000	0.063	0.059	0.067	8.0
0.25	0.082	0.167	0.100	0.150	0.102	0.140	12.9
0.35	0.269	0.367	0.158	0.286	0.275	0.260	13.3
0.45	0.337	0.593	0.600	0.595	0.409	0.385	12.4
0.55	0.481	0.615	0.381	0.511	0.492	0.505	11.7
0.65	0.629	0.609	0.625	0.615	0.624	0.625	10.2
0.75	0.919	0.789	0.760	0.773	0.858	0.750	10.0
0.85	0.804	0.889	0.833	0.857	0.821	0.870	6.3
0.95	0.929	1.000	1.000	1.000	0.952	0.952	3.9
1.146	1.000	1.000	0.929	0.958	0.980	0.980	4.6
Columns	(1)	& (2)	& (3)	&(4)		(5)&(6)	
r		0.970	0.947	0.970		0.995	
E.E.(8)		0.249	0.293	0.211		0.102	
E.E.(9)		0.327	0.284	0.279		0.142	
E.E.(10)		0.316	-	0.266		0.141	
Percent Correct	78.2	74.0	73.8	73.9	76.7		
Skill Score	0.56	0.47	0.46	0.48	0.53		
Number of Occ	294	102	81	183	477		
Total No	688	227	149	376	1064		

The above results can be used to indicate it is important to forecast the 00Z RAOB for a JJA CBPRE forecast. The drop-off in S.S. for the 12Z 1979-83 equation results is marked. This is not true for the 00Z equations.

RH4, explained 39.9 percent. The skill scores on the dependent and two independent data sets were 0.65, 0.63 and 0.63, respectively. The overall skill score was 0.64 and the percent correct was 82.7. The independent data E.E. were 0.134 and 0.491. The second value depended on a low relative frequency for 1982-83 in the eighth class (R = 0.30-0.40). Equation 33 cannot

Table 10. Equation 27 12Z Radiosonde Cumulonimbus or Precipitation Objective Forecast Statistics for June 15 to August 31.

	Frequencies of Occurence by R Class					(6)	(7)
	(1)	(2)	(3)	(4)	(5)	Man Smooth	% of Total
Years	70-78	79-81	82-83	79-83	70-83	70-83	70-83
R							
-0.095	0.000	0.071	0.125	0.091	0.034	0.034	5.5
0.05	0.067	0.048	0.167	0.074	0.069	0.062	6.8
0.15	0.052	0.000	0.286	0.067	0.056	0.100	10.1
0.25	0.143	0.286	0.143	0.257	0.179	0.160	10.5
0.35	0.257	0.400	0.267	0.356	0.294	0.250	11.2
0.45	0.267	0.500	0.500	0.500	0.344	0.355	8.5
0.55	0.492	0.556	0.389	0.472	0.485	0.485	9.5
0.65	0.603	0.792	0.571	0.711	0.642	0.645	10.0
0.75	0.893	0.727	0.733	0.731	0.841	0.760	7.7
0.85	0.895	0.882	0.667	0.781	0.843	0.836	6.6
0.95	0.774	0.750	0.833	0.800	0.784	0.891	4.8
1.138	1.000	1.000	0.917	0.943	0.979	0.969	8.9
Columns	(1)	& (2)	& (3)	& (4)		(5)&(6)	
r		0.942	0.927	0.955		0.990	
E.E.(8)		0.294	0.266	0.266		0.082	
E.E.(9)		0.355	0.251	0.314		0.086	
E.E.(10)		-	0.498	0.309		0.196	
Percent Correct	81.1	76.7	71.1	74.5	78.8		
Skill Score	0.62	0.52	0.41	0.49	0.57		
Number of Occ	294	102	81	183	477		
Total No	688	227	149	376	1064		

be used to forecast better than 90 percent probability. It can be used to forecast zero probability 8.8 percent of the time. The drop in skill scores experienced by the 12Z equations on the independent data does not occur for equation 33.

The 1980-83 equation 11 based on all five months also performed relatively

and 0.018. Equation 11 forecasts occurences 7.2 percent less often than observed (Table A.28.). The probability of occurence was greater than 90 for 5.4 percent of the sample compared to 11.0 percent for equation 34. The frequency of occurence was less than five percent for 27.1 percent of the sample (R < 0.2).

The MJS equations are compared in Table 9. The overall best equation appears to be the 00Z RAOB equation 34. The 12Z RAOB equations 30 and 31 produce more reliable probability forecasts but are correct 4.4 percent fewer times for the whole sample.

Table. 9. May-June 14 and September Cumulonimbus or Precipitation Forecast Equations Performance.

Years	1970-78		1979-81		1982-83		1970-83		1979-81		1982-83	
Eqn	S.S.	% Corr	S.S.	% Corr	S.S.	% Corr	S.S.	% Corr	Eight Case E.E.	B.S.S.	Eight Case E.E.	B.S.S.
MJS 12Z Radiosonde Equations												
30	0.63	81.6	0.64	82.2	0.57	78.9	0.63	81.3	0.21	0.013	0.19	0.008
31	0.63	81.4	0.64	81.8	0.59	80.3	0.63	81.3	0.23	0.008	0.21	0.009
MJS 00Z Radiosonde Equations												
34	0.73	86.9	0.71	85.5	0.59	79.9	0.71	85.6	0.27	0.025	0.20	0.017
11	0.70	85.3	0.73	86.4	0.73	86.8	0.71	85.7	0.36	0.019	0.29	0.018

h. Evaluation of Results for Four June 15-August 31 (JJA) Cumulonimbus or Precipitation Forecast Equations. Equation 27 (Appendix D) was the only CBPRE forecast equation fitted to the 12Z 1970-78 JJA data. It explained 42.8 percent of the variance. The best predictor, RH4 explained 33.1 percent of the variance. Table 10 summarizes the equation 27 performance. The skill scores were 0.62 for the nine dependent data years, 0.52 for 1979-81 and 0.41 for 1982-83. The 1970-83 S.S. was 0.57 and the percent correct was 78.8. The E.E was 0.29 for 1979-81 and 0.27 for 1982-83. Equation 27 forecasts 90 percent or better probabilites 8.9 percent of the time (see Table 10 column 7).

The second best equation tested on JJA 12Z data was equation 16. This equation was obtained from manually reduced 1980-83 data for all five months. It explained 39.1 percent of the variance of the 1980-83 data sample. The best predictor, RH4 explained 29.3 percent. The skill scores were 0.56 for 1970-78, 0.47 for 1979-81 and 0.46 for 1982-83. These results support the idea implied by the equation 27 scores that the 1979-83 years were relatively difficult to forecast using the 12Z RAOB. From Table 11 it can be seen that equation 16 can be used to forecast probabilities better than 90 percent 8.5 percent of the time and zero probabilities 2.1 percent of the time.

The only equation fitted to the 1970-78 JJA 00Z data was equation 33 (Table 12). It explained 47.6 percent of the variance. The best predictor,

evaluate equation 11, the same comparisons as above will be made, even though the dependent and independent data distinction is less clear. As indicated in Table 8, the skill scores were 0.70 for 1970-78, 0.73 for 1979-81 as well as 1982-83. The S.S. for 1970-83 was 0.71. The 1970-83 percent correct was 85.7. The equation 11 probability forecasts are less reliable than those of equation 34 (Table 7) as indicated by the larger values of E.E. for the data periods 1979-81 and 1982-83, and the smaller number of times that the frequency of occurence is zero (15.7 percent of the time for equation 34 and 9.9 percent for equation 11). The correlations between the 1970-78, 1979-81 and 1982-83 frequencies were 0.98 and 0.97. The E.E. were 0.36 and 0.29, respectively,

Table 8. Equation 11 00Z Radiosonde Cumulonimbus or Precipitation Objective Forecast Statistics for May 1 to June 14 and September.

	Frequencies of Occurence by R Class					(6)	(7)
	(1)	(2)	(3)	(4)	(5)	Man Smooth	% of Total
Years	70-78	79-81	82-83	79-83	70-83	70-83	70-83
R							
-0.106	0.000	0.000	0.000	0.000	0.000	0.000	9.9
0.05	0.018	0.000	0.000	0.000	0.014	0.020	7.2
0.15	0.038	0.000	0.000	0.000	0.029	0.060	10.0
0.25	0.183	0.029	0.100	0.045	0.130	0.130	11.2
0.35	0.253	0.105	0.188	0.143	0.220	0.245	11.5
0.45	0.556	0.368	0.273	0.333	0.484	0.460	9.0
0.55	0.727	0.571	0.533	0.552	0.667	0.670	8.2
0.65	0.870	0.682	0.857	0.750	0.817	0.817	8.0
0.75	0.957	0.875	0.833	0.853	0.914	0.905	7.9
0.85	0.949	0.933	1.000	0.966	0.956	0.942	6.6
0.95	1.000	0.833	1.000	0.913	0.963	0.960	5.2
1.092	0.963	0.950	1.000	0.966	0.964	0.965	5.4
Columns	(1)	& (2)	& (3)	& (4)		(5)&(6)	
r		0.983	0.972	0.983		0.999	
E.E.(8)		0.355	0.290	0.291		0.043	
E.E.(9)		0.589	0.336	0.488		0.041	
E.E.(10)		-	-	-		0.224	
Percent Correct	85.3	86.4	86.8	86.6	85.7		
Skill Score	0.70	0.73	0.73	0.73	0.71		
Number of Occ	292	90	76	166	458		
Total No	672	214	144	358	1030		

slightly worse than equation 34 values of 0.27 and 0.20. The B.S.S. were 0.019

the percent correct 85.6, four percent better than the 12Z RAOB equations. The correlation coefficients between the dependent data and and each of the 12 case independent data frequency sets were 0.99 and 0.97. The E.E. scores for the compared eight-class frequency sets were 0.27 and 0.20. The B.S.S. were 0.025 and 0.017. Again, as for equation 31 above, the screened sample equation now being tested on the whole sample, forecasts a number of occurences greater than the number observed, in this case 7.9 percent greater (Table A.28).

Table 7. Equation 34 00Z Radiosonde Cumulonimbus or Precipitation Objective Forecast Statistics for May 1 to June 14 and September.

	Frequencies of Occurence by R Class					(6) Man Smooth	(7) % of Total
	(1)	(2)	(3)	(4)	(5)		
Years	70-78	79-81	82-83	79-83	70-83	70-83	70-83
R							
-0.125	0.000	0.000	0.000	0.000	0.000	0.000	9.0
0.05	0.000	0.000	0.000	0.000	0.000	0.015	6.7
0.15	0.050	0.000	0.000	0.000	0.037	0.037	7.9
0.25	0.077	0.000	0.000	0.000	0.049	0.076	9.9
0.35	0.211	0.130	0.250	0.171	0.198	0.170	10.3
0.45	0.345	0.227	0.375	0.267	0.318	0.340	8.3
0.55	0.585	0.444	0.462	0.455	0.547	0.545	7.3
0.65	0.784	0.647	0.500	0.568	0.693	0.693	8.5
0.75	0.864	0.800	0.750	0.778	0.837	0.810	8.3
0.85	0.939	0.714	0.800	0.750	0.841	0.880	6.7
0.95	0.973	0.882	1.000	0.923	0.952	0.936	6.1
1.115	0.968	0.962	1.000	0.980	0.973	0.973	11.0
Columns	(1)	& (2)	& (3)	& (4)		(5)&(6)	
r		0.988	0.971	0.986		0.999	
E.E.(8)		0.273	0.204	0.205		0.062	
E.E.(9)		-	-	-		0.156	
E.E.(10)		-	-	-		0.148	
Percent Correct	86.9	85.5	79.9	83.2	85.6		
Skill Score	0.73	0.71	0.59	0.67	0.71		
Number of Occ	292	90	76	166	458		
Total No	672	214	144	358	1030		

Equation 11 (see Appendix D) was the second MJS CBPRE equation and was formulated from the 00Z RAOB 1980-83 manually-reduced sample for all five months. When tested on the MJS sample, it performed better than the 1970-78 MJS 00Z dependent data equation 32 (based on an unscreened data sample). To

The best MJS CBPRE equation determined using the parameters based on the 00Z RAOB analysis was 34 (see Appendix D). The data used for this analysis were screened in the same fashion as for equation 31 above. The September data were screened so that occurences and non-occurences were equal in number. The first predictor, RH4, reduced the variance by 37.9 percent. The total equation 34 reduction in variance was 50.2 percent. One of the interesting things about equation 34 is the relatively large percent (15.7) of no occurences for the whole sample (1970-83) if R < 0.1 (see column 7 of Table 7) and a less than five percent probability of occurence for 23.6 percent of the sample (R < 0.2).

Table 6. Equation 31 12Z Radiosonde Cumulonimbus or Precipitation Objective Forecast Statistics for May 1 to June 14 and September.

	Frequencies of Occurence by R Class					(6) Man Smooth	(7) % of Total
Years	(1) 70-78	(2) 79-81	(3) 82-83	(4) 79-83	(5) 70-83	70-83	70-83
R							
-0.121	0.040	0.000	0.091	0.053	0.043	0.043	6.8
0.05	0.000	0.000	0.333	0.133	0.036	0.045	5.4
0.15	0.050	0.091	0.083	0.088	0.064	0.063	9.5
0.25	0.245	0.278	0.300	0.286	0.260	0.120	7.4
0.35	0.235	0.136	0.200	0.156	0.212	0.210	11.1
0.45	0.313	0.241	0.545	0.325	0.318	0.345	10.7
0.55	0.537	0.563	0.615	0.586	0.552	0.520	9.4
0.65	0.648	0.571	0.722	0.656	0.651	0.665	8.7
0.75	0.833	0.765	0.813	0.788	0.817	0.795	8.8
0.85	0.950	0.773	0.929	0.833	0.895	0.910	7.2
0.95	0.959	1.000	1.000	1.000	0.974	0.970	7.9
1.104	1.000	1.000	1.000	1.000	1.000	1.000	7.1
Column (1)		& (2)	& (3)	& (4)		(5)&(6)	
r		0.984	0.961	0.987		0.994	
E.E.(8)		0.230	0.210	0.156		0.038	
E.E.(9)		0.221	0.209	0.156		0.248	
E.E.(10)		0.279	0.253	0.208		0.236	
Percent Correct	81.4	81.8	80.3	81.2	81.3		
Skill Score	0.63	0.64	0.59	0.62	0.63		
Number of Occ	297	101	88	189	486		
Total No	651	214	147	361	1012		

The skill scores for the equation 34 dependent and two independent data samples were 0.73, 0.71 and 0.59 respectively. The overall skill score was 0.71 and

sensitive comparison is an error estimate (E.E.), defined here as

$$E.E.(N) = (1/N \sum_{i=1}^{N}((F(1)_i - F(2)_i)/((F(1)_i + F(2)_i)*0.5))^2)^{1/2} \quad (6)$$

where: F(1) = dependent data frequency
F(2) = independent data frequency
N = number of frequency classes

The number of frequency classes N was counted from large to smaller frequencies. E.E. terms involving division by zero are not defined. E.E. is very sensitive to small differences for the lowest frequencies. For instance if both frequencies are zero the E.E. value for that class is indeterminate. If one is zero and the other is any value greater than zero, the contribution of that term is four, a very large contribution, e.g.

$$((0.00 - 0.04)/((0.00 + 0.04)*0.5))^2 = 4.00$$

The E.E.(10) in column two of Table 6 is 0.279. If the above term were added to the other terms to obtain an E.E.(11) the result would be a value of 0.662. This is a large increase for a relatively insignificant difference in the frequencies. The calculation of E.E. was made for as many classes as it remained well-behaved. Inspection of Tables 5 through 8 and 10 through 13 indicates that a value of N equal to eight is the highest number for which E.E. is consistently well-behaved. The E.E. values were also calculated for N equal to nine and ten, but for comparison purposes in the text, E.E.(8) will be used. In the Table 5 MJS 12Z CBPRE equation 30 comparison between the dependent data and 1979-81 frequencies, E.E. was 0.21 and for 1982-83, it was 0.19. Brier skill scores (B.S.S.) (Reference 24) were 0.013 and 0.008, respectively, where

$$B.S.S.(N) = 1/N \sum_{i=1}^{N}(F(1)_i - F(2)_i)^2 \quad (7)$$

Equation 31 was the second 12Z MJS CBPRE equation. It was formulated using the BMDP2R program and a screened data set where occurences and non-occurences for September were each 50 percent of the sample. The purpose of this analysis was to compare the results of equation 31 to equation 30. The first predictor selected by the program was LINWS which explained 28.6 percent of the variance on the dependent data sample. The total reduction in variance through use of equation 31 was 40.1 percent. The skill scores for dependent data and two independent data sets were 0.63, 0.64 and 0.59 respectively (Table 6). The percent correct was always 80 or better, with an average value of 81.3. E.E. values were 0.23 and 0.21 for the two independent data sets, slightly less good than equation 30. B.S.S. values were 0.007 and 0.009. From the dependent data contingency table A.28, it can be seen that equation 31 overforecasts occurences by 2.3 percent. It forecasts yes for a no occurence case 12.4 percent more often than it forecasts no for a yes case. With the exception of 1982-83 (Table A.7), the distribution is similar for the independent data. There appears to be very little choice between equations 30 and 31. The first underpredicts CBPRE. The second overpredicts.

forecasts (Reference 13) of CB were also based on the observed 12Z RAOB and verified in the subsequent 24 hour period. His percent reduction in variance figure was 43.0. Table 5 summarizes the performance of equation 30. The skill score was 0.63 for the dependent data (1970-78), 0.64 for 1979-81, 0.57 for 1982-83 and 0.63 for 1970-83. The overall percent correct was 81.3 and varied only slightly for dependent and independent data. The 1970-83 contingency table (A.13) indicates that the number of cases observed was five percent more than the number forecast.

Table 5. Equation 30 12Z Radiosonde Cumulonimbus or Precipitation Objective Forecast Statistics for May 1 to June 14 and September.

	Frequencies of Occurence by R Class					(6) Man Smooth	(7) % of Total
Years	(1) 70-78	(2) 79-81	(3) 82-83	(4) 79-83	(5) 70-83	70-83	70-83
R							
-0.106	0.036	0.000	0.154	0.091	0.051	0.020	7.7
0.05	0.000	0.083	0.286	0.158	0.044	0.062	6.7
0.15	0.117	0.083	0.143	0.105	0.112	0.120	9.7
0.25	0.211	0.217	0.333	0.241	0.221	0.185	8.5
0.35	0.274	0.238	0.231	0.235	0.263	0.265	11.7
0.45	0.375	0.250	0.615	0.378	0.376	0.376	10.0
0.55	0.579	0.692	0.615	0.654	0.602	0.540	8.1
0.65	0.692	0.533	0.706	0.625	0.670	0.740	9.8
0.75	0.911	0.722	0.938	0.824	0.873	0.850	7.7
0.85	0.957	0.857	0.909	0.875	0.923	0.925	7.0
0.95	0.941	1.000	1.000	1.000	0.968	0.970	6.6
1.101	1.000	1.000	1.000	1.000	1.000	1.000	6.5
Columns	(1)	& (2)	& (3)	& (4)		(5)&(6)	
r		0.969	0.966	0.984		0.996	
E.E.(8)		0.209	0.186	0.094		0.053	
E.E.(9)		0.197	0.230	0.099		0.077	
E.E.(10)		0.216	0.227	0.100		0.077	
Percent Correct	81.6	82.2	78.9	80.9	81.3		
Skill Score	0.63	0.64	0.57	0.62	0.63		
Number of Occ	297	101	88	189	486		
Total No	651	214	147	361	1012		

Comparison of the Table 5 frequencies of occurence by R class produced correlations (r) of 0.969 AND 0.966 between the twelve classes of dependent data (column 1) and the independent data sets (columns 2 and 3). A more

4 is a modified version of Table A.2. Table 4 is the MJS 12Z RAOB data CBPRE equation 30 frequency table. In this table, the calculated results (R) of equation 30 have been tabulated for each one-tenth R class. In Table 4, column a, the number of occurences for each R class are listed. In column b, the total number of cases for the R class are listed. The number of non-occurences is the figure in column b minus the figure in column a. The number of occurences per class has been divided by the total number in that class to produce a frequency (column c). In the column "percent of total", the percent of the total sample number appearing in each R(30) class has been presented (100 times column b figures divided by the total number of 651). Frequency tables similar to Table 4 appear in the appendices A, B and C. The column meanings for the appendix tables are the same as for Table 4. It can be seen from Table 4 that the frequency of occurence increases monotonically with R with two exceptions, the 0.0 to 0.1 and the 0.9 to 1.0 classes. The figures in Table 4 indicate it is possible to forecast occurence of CBPRE with a confidence better than 90 percent 11.3 percent of the time (i.e. for any R(30) value greater than 0.9). To test the adequacy of the dependent data results in Table 4, the frequencies of occurence (column c) will be correlated with corresponding frequencies for two independent data samples, 1979-81 and 1982-83.

Table 4. Equation 30 Frequency Table for MJS CBPRE 1970-78.

One Tenth R Class Limits	Mean	a Number of Occurences	b Total Number	c Freq (a/b)	% of Total (100*b/651)
-1.0 - -0.0	-0.106	2	56	0.036	8.6
0.0 - 0.1	0.058	0	49	0.000	7.5
0.1 - 0.2	0.145	7	60	0.117	9.2
0.2 - 0.3	0.250	12	57	0.211	8.8
0.3 - 0.4	0.351	23	84	0.274	12.9
0.4 - 0.5	0.450	24	64	0.375	9.8
0.5 - 0.6	0.545	33	56	0.589	8.6
0.6 - 0.7	0.647	45	67	0.672	10.3
0.7 - 0.8	0.754	41	44	0.932	6.8
0.8 - 0.9	0.852	38	40	0.950	6.1
0.9 - 1.0	0.948	36	38	0.947	5.8
1.0 - 2.0	1.101	36	36	1.000	5.5
-1.0 - 2.0	Avg 0.453	Tot 297	Tot 651	Avg 0.456	Tot 100.0

g. Evaluation of Results for Four May to June 14 and September (MJS) Cumulonimbus or Precipitation Forecast Equations. Stepwise multiple regression analysis of the 1970-78 12Z RAOB data performed using the BMDP2R program produced CBPRE equation 30 (see Appendix D)

$$R(30) = 0.02391 + 0.00764*SURDEP + 0.00338*V5 - 0.002421*U5 + 0.00352*V7 + 0.02998*UII + 0.01160*RH4 - 0.02602*LINWS$$

Equation 30 explained 44.5 percent of the variance of CBPRE. The first predictor chosen, LINWS, explained 32.1 percent of the variance. Randerson's

for 12Z and 34 and 11 for 00Z. For JJA, the best two 12Z equations were 27 and 16. For 00Z, the best two were 33 and 11. The basis of the evaluations which led to the choice of equations appears in the next section.

f. The Basis of Verification. Panofsky and Brier (Reference 22) point out that in the use of meteorological data to determine relationships by multiple regression analysis, it is difficult to obey the desirable rule of independency of the predictor variables. Meteorological variables tend to be interrelated to a high degree and these data may or may not be normally distributed. Panofsky and Brier suggest using statistical evaluation techniques which test specific results of the study, preferably on two independent-data samples. The accepted forecast methodology must; first, be correct as often as possible with an accompanying maximization of skill, and second, produce reliable forecast occurence probabilities when tested using independent data. To evaluate the achievement of the first goal, contingency table skill scores and percent correct (Reference 22) were used. To evaluate the second goal, occurence frequencies of the dependent data were compared to those of two independent data samples.

The contingency table skill score (S.S.) evaluation technique is symbolically represented in Table 3. The S.S. is calculated from

S.S. = ((No. of correct forecasts) - E)/((Total number) - E) (5)

where E = expected value = $((x+z)*(x+y) + (y+w)*(z+w))/(x+y+z+w)$

Table 3. Contingency Table used in Computing Verification Scores.

	Observed		
Forecast	Yes	No	Total
Yes	x	z	x+z
No	y	w	y+w
Total	x+y	z+w	x+y+z+w

There are several desired relationships in a contingency table. One is to make no mistakes and get a S.S. of one. With reference to Table 3, Donaldson et al (Reference 23) suggest using the scores; probability of detection (POD) given by $x/(x+y)$, false alarm ratio (FAR) given by $z/(x+z)$ and the critical success index (CSI) or threat score given by $x/(x+y+z)$.

The second basis of verification is the comparison of forecast probabilities of occurence. Dependent data frequencies of occurence can be used as probabilities if a given equation is a good one and the dependent data sample is both large enough and representative. To test the hypothesis that the equation is a good one, dependent data frequencies will be compared to frequencies found for two independent data sets. A sample dependent data frequency table which will be used to initiate this effort is Table A.2. Table

reduction in variance was 20.9. The S.S. basis of a yes forecast was an R value of 0.35 or more. The performance was somewhat better than for equation 37 with respective skill scores of 0.49, 0.25 and 0.27 on the three data samples. The 1970-83 percent correct was 78.1 for equation 37 and 82.9 for equation 44. From Table B.13 in appendix B, it can be seen that for the years 1970-83, a yes forecast was correct 37 percent of the time for equation 37 and 58.5 percent of the time for equation 44. From Table 15 it can be seen that equation 44 probabilities of occurence average 52.4 percent for 4.2 percent of the data (R(44) > 0.49) compared to an equation 37 average of 41.8 percent TSTM frequency for 12.4 percent of the data (R(37) > 0.69). The comparative E.E. values for the TSTM equations are based on the three highest frequency data classes. The E.E. for equation 37 were 0.36 and 0.14 for 1979-81 and 1982-83. Equation 44 values were 0.28 and 0.24.

The percent reduction in variance of the above equations appears small compared to the CBPRE forecast equations. The NWS TSTM study (Reference 5) was implemented using radar echoes of VIP4 or more over an area of 4900 square miles. This was an area forecast study for the eastern United States so that the relative probabilities of occurence at each point make a significant contribution to skill. This was done by forming an equation using the product of the K index and the relevant climatological probability. Use of K alone resulted in a percent reduction in variance of 16.8 percent. Use of an equation which included only the predictor formulated from the product of K and probability resulted in a percent reduction of variance of 28.9. The final equation included seven more predictors and produced a percent reduction in variance of 32.6. The average TSTM forecast probability was 33.0 percent. The average observed probability was almost the same. The equation results were also compared to surface observations of TSTM reported at stations located in the various grid squares. The resultant average observed probability was 16.6 percent, half the average equation value. The average observed probability is comparable to the SLC average observed probability of 16 percent for MJS and 19 percent for JJA.

The best 00Z MJS RAOB TSTM forecast equation results appear in Table 16. Equation 21 was derived from the 1980-83 May-September screened data sample (50-50 TSTM or no TSTM). For equation 21, the percent reduction in variance was 23.9. The 1970-83 percent correct is less than for the 12Z equation 44. The overall skill score is also less. Equation 45 was obtained through analysis of all of the 1970-78 00Z data. The percent reduction in variance was 24.3. The percent correct for this equation improved over the 12Z equations for all the data periods, but the 1970-83 skill score was the same as that for the 12Z equation 44. The percent correct was 2.5 higher.

Table 16. Equations 21 and 45 00Z Radiosonde Thunder Objective Forecast Statistics for May 1 to June 14 and September.

	Equation 21 Frequencies of Occurence by R Class					(6) Man Smooth	(7) % of Total
	(1)	(2)	(3)	(4)	(5)		
Years	70-78	79-81	82-83	79-83	70-83	70-83	70-83
R							
< 0.1	0.000	0.000	0.000	0.000	0.000	0.000	21.0
0.1-0.3	0.033	0.000	0.037	0.014	0.027	0.065	21.7
0.3-0.5	0.191	0.062	0.079	0.068	0.147	0.140	27.9
0.5-0.7	0.231	0.273	0.237	0.256	0.241	0.237	20.7
0.7-0.9	0.350	0.520	0.308	0.447	0.397	0.380	7.6
≥ 0.9	0.800	1.000	1.000	1.000	0.833	0.857	1.2
Columns (1)		& (2)	& (3)	& (4)		(5)&(6)	
r		0.978	0.982	0.985		0.998	
E.E.(3)		0.277	0.149	0.199		0.032	
E.E.(4)		0.563	0.434	0.505		0.037	
E.E.(5)		-	0.392	0.579		0.371	
% Corr	81.7	87.4	76.3	83.0	82.1		
S.S.	0.26	0.57	0.16	0.41	0.32		
No Occ	92	30	18	48	140		
Total No	672	214	139	353	1025		

	Equation 45 Frequencies of Occurence by R Class					(6) Man Smooth	(7) % of Total
	(1)	(2)	(3)	(4)	(5)		
Years	70-78	79-81	82-83	79-83	70-83	70-83	70-83
R							
< 0.05	0.008	0.000	0.036	0.014	0.009	0.009	31.2
0.05-0.15	0.026	0.038	0.067	0.048	0.034	0.034	23.1
0.15-0.25	0.165	0.024	0.115	0.059	0.126	0.126	17.9
0.25-0.35	0.309	0.321	0.138	0.228	0.275	0.275	13.5
0.35-0.50	0.511	0.394	0.200	0.333	0.419	0.419	9.1
0.50-3.00	0.613	0.417	0.455	0.435	0.537	0.537	5.3
Columns (1)		& (2)	& (3)	& (4)		(5)&(6)	
r		0.948	0.391	0.984		1.000	
E.E.(3)		0.267	0.692	0.358		0.000	
E.E.(4)		0.781	0.626	0.566		0.000	
E.E.(5)		0.718	0.684	0.572		0.000	
% Corr	87.5	81.8	80.6	81.3	85.4		
S.S.	0.43	0.38	0.26	0.33	0.39		

In Table 17, the MJS TSTM equation performance results for 12Z and 00Z are summarized. The E.E. and the B.S.S. have been calculated for the three highest probability classes. Inspection of Table 16 indicates that the large 1982-83 E.E. value for equation 45 is due to two frequencies which are less than half the 1970-78 values. Equation 21 is a more reliable equation for forecasting probabilities. In spite of the poor E.E., equation 45 skill scores for 1970-78, 1979-81 and 1982-83 are highest for two out of three periods. The equation 45 S.S. of 0.39 for 1970-83 ties for best with the 12Z RAOB equation 44. In summary, the overall best equation appears to be the 12Z equation 44. The E.E. are consistently small. For R values of 0.3 or more, the variation of the independent data probabilities from the 1970-83 equation 44 probability is less than 24 percent for the worst case and less than five percent for the best (see Table 15).

Table 17. May to June 14 and September Thunder Forecast Equations Performance.

Years	1970-78		1979-81		1982-83		1970-83		1979-81		1982-83	
Eqn	S.S.	% Corr	S.S.	% Corr	S.S.	% Corr	S.S.	% Corr	Three E.E.	Case B.S.S.	Three E.E.	Case B.S.S.
MJS 12Z Radiosonde Equations												
37	0.34	79.5	0.33	79.9	0.19	74.1	0.31	78.1	0.36	0.018	0.14	0.001
44	0.49	87.6	0.25	75.7	0.27	75.5	0.39	82.9	0.28	0.009	0.24	0.009
MJS 00Z Radiosonde Equations												
21	0.26	81.7	0.57	87.4	0.16	76.3	0.32	82.1	0.28	0.024	0.15	0.014
45	0.43	87.5	0.38	81.8	0.26	80.6	0.39	85.4	0.27	0.017	0.69	0.050

k. Evaluation of the JJA Thunder (TSTM) Equations. SLC summer thunder is expected to be more closely related to local penetrative convection. The MJS thunder formation frequently occurs with a trigger mechanism associated with synoptic developments. For this reason, an objective forecast approach should work better during the summer months. The best JJA 12Z thunder equations were 41 and 46 (see Table 18). The former was based on a screened 50-50 1970-78 JJA sample and was evaluated using an R value of 0.6 or better. The latter was based on the whole 1970-78 JJA sample and was evaluated using an R value of 0.35 or better. The equation 41 percent reduction in variance was 25.1. The skill scores were 0.44, 0.37 and 0.26 for 1970-78, 1979-81 and 1982-83 respectively. The E.E. were 0.35 and 0.19 for the latter two periods as compared to 1970-78. The equation 46 percent reduction in variance was 27.6. The skill scores were 0.51, 0.43 and 0.26 for the same three periods and the E.E. were 0.19 and 0.40. The 1970-83 skill scores were 0.40 for equation 41 and 0.45 for equation 46. Inspection of the frequencies in Table 18 indicates that for the higher probabilities of occurence (0.42 or better) equation 46 results are more useful. Two percent of the time (for an R value of 0.7 or more) equation 46 probabilities of occurence are 89 percent or better. This is the highest independent data probability result for any of the TSTM equations.

Table 18. Equations 41 and 46 12Z Radiosonde Thunder Objective Forecast Statistics for June 15 to August 31.

	Equation 41 Frequencies of Occurence by R Class					(6) Man Smooth	(7) % of Total
	(1)	(2)	(3)	(4)	(5)		
Years	70-78	79-81	82-83	79-83	70-83	70-83	70-83
R							
< 0.1	0.000	0.000	0.065	0.033	0.013	0.013	14.7
0.1-0.3	0.042	0.063	0.133	0.077	0.053	0.055	23.1
0.3-0.5	0.134	0.104	0.207	0.135	0.135	0.135	29.3
0.5-0.7	0.323	0.385	0.268	0.325	0.324	0.318	19.2
0.7-0.9	0.517	0.300	0.444	0.383	0.458	0.458	10.1
≥ 0.9	0.833	0.667	0.667	0.667	0.769	0.769	3.7
Columns (1)		& (2)	& (3)	& (4)		(5)&(6)	
r		0.955	0.993	0.993		1.000	
E.E.(3)		0.347	0.189	0.214		0.011	
E.E.(4)		0.326	0.269	0.186		0.009	
E.E.(5)		0.342	0.524	0.311		0.019	
% Corr	83.1	79.3	68.5	75.0	80.3		
S.S	0.44	0.37	0.26	0.33	0.40		
No Occ	127	38	37	75	202		
Total	688	227	149	376	1064		

	Equation 46 Frequencies of Occurence by R Class					(6) Man Smooth	(7) % of Total
	(1)	(2)	(3)	(4)	(5)		
Years	70-78	79-81	82-83	79-83	70-83	70-83	70-83
R							
< 0.1	0.021	0.046	0.029	0.041	0.027	0.027	38.2
0.1-0.3	0.123	0.110	0.239	0.156	0.136	0.136	31.9
0.3-0.5	0.409	0.351	0.225	0.286	0.363	0.363	19.2
0.5-0.7	0.614	0.471	0.421	0.444	0.548	0.548	8.7
0.7-0.9	0.889	1.000	0.889	0.923	0.909	0.909	2.1
≥ 0.9	-	-	-	-	-	-	0.0
Column (1)		& (2)	& (3)	& (4)		(5)&(6)	
r		0.969	0.926	0.961		1.000	
E.E.(3)		0.188	0.398	0.277		0.000	
E.E.(4)		0.173	0.471	0.267		0.000	
E.E.(5)		0.368	0.445	0.375		0.000	
% Corr	84.4	82.8	67.1	76.6	81.7		
S.S.	0.51	0.43	0.26	0.36	0.45		

Table 19. Equations 36 and 47 00Z Radiosonde Thunder Objective Forecast Statistics for June 15 to August 31.

	Equation 36 Frequencies of Occurence by R Class					(6) Man Smooth	(7) % of Total
	(1)	(2)	(3)	(4)	(5)		
Years	70-78	79-81	82-83	79-83	70-83	70-83	70-83
R							
< 0.1	0.000	0.000	0.000	0.000	0.000	0.000	8.9
0.1-0.3	0.034	0.016	0.000	0.012	0.028	0.032	27.0
0.3-0.5	0.131	0.089	0.053	0.078	0.113	0.113	32.4
0.5-0.7	0.317	0.200	0.265	0.226	0.280	0.285	19.5
0.7-0.9	0.532	0.667	0.553	0.589	0.563	0.563	9.7
≥ 0.9	0.813	1.000	0.600	0.818	0.815	0.815	2.5
Columns	(1)	& (2)	& (3)	& (4)		(5)&(6)	
r		0.983	0.971	0.993		1.000	
E.E.(3)		0.315	0.204	0.202		0.010	
E.E.(4)		0.333	0.459	0.308		0.009	
E.E.(5)		0.439	-	0.509		0.060	
% Corr	85.4	85.5	75.5	81.7	84.1		
S.S.	0.45	0.50	0.45	0.49	0.47		
No Occ	114	36	35	71	185		
Total	693	228	143	371	1064		

	Equation 47 Frequencies Occurence by R Class					(6) Man Smooth	(7) % of Total
	(1)	(2)	(3)	(4)	(5)		
Years	70-78	79-81	82-83	79-83	70-83	70-83	70-83
R							
< 0.1	0.022	0.023	0.000	0.019	0.021	0.021	39.8
0.1-0.3	0.158	0.114	0.115	0.114	0.142	0.142	35.7
0.3-0.5	0.411	0.278	0.346	0.318	0.365	0.365	16.7
0.5-0.7	0.533	0.786	0.538	0.667	0.596	0.596	5.4
0.7-2.0	0.889	-	0.667	0.875	0.846	0.846	2.5
Columns	(1)	& (2)	& (3)	& (4)		(5)&(6)	
r		0.965	0.933	0.974		1.000	
E.E.(3)		0.301	0.192	0.196		0.000	
E.E.(4)		0.262	0.229	0.234		0.000	
E.E.(5)		-	-	0.220		0.000	
% Corr	86.0	85.5	74.8	81.4	84.4		
S.S.	0.46	0.51	0.44	0.49	0.48		

There is very little difference between the performance of the best two 00Z JJA TSTM equations (Table 19). The first, equation 36, was based on a 1970-78 50-50 JJA sample and was verified by using a S.S. cut-off value of 0.6.

The second, equation 47, was based on the whole 1970-78 JJA data sample. The skill score basis of a yes forecast was an R of 0.35 or more. The equation 36 percent reduction in variance was 23.5. The S.S. were 0.45, 0.50 and 0.45. The 1970-83 S.S. was 0.47. The percent correct was 84.1. Equation 36 forecasts a probability of occurence of 0.5 or better 12.2 percent of the time. The equation 47 percent reduction in variance was 27.5. The S.S. were 0.46, 0.51 and 0.44. The 1970-83 S.S. was 0.48. The percent correct was 84.4. Equation 47 forecasts a probability of 0.5 or better 7.9 percent of the time (R(47) > 0.49 in Table 19).

The summarized results for the JJA thunder equations appear in Table 20. The overall choice would appear to be the 12Z equation 46. The percent correct and skill scores are higher than equation 41. Also, for 10.8 percent of the sample, the equation 46 probability forecasts are 0.42 or better. If the 00Z RAOB were accurately forecast, equation 47 would be preferred for its better and more consistent skill scores, percent correct and E.E. values.

Table 20. June 15 to August 31 Thunder Forecast Equations Performance.

Years	1970-78		1979-81		1982-83		1970-83		1979-81		1982-83	
Eqn	S.S.	% Corr	S.S.	% Corr	S.S.	% Corr	S.S.	% Corr	Three E.E.	Case B.S.S.	Three E.E.	Case B.S.S.
JJA 12Z Radiosonde Equations												
41	0.44	83.1	0.37	79.3	0.26	68.5	0.40	80.3	0.35	0.026	0.19	0.012
46	0.51	84.4	0.43	82.8	0.26	67.1	0.45	81.7	0.19	0.012	0.40	0.024
JJA 00Z Radiosonde Equations												
36	0.45	85.4	0.50	85.5	0.45	75.5	0.47	84.1	0.32	0.022	0.20	0.016
47	0.46	86.0	0.51	85.5	0.44	74.8	0.48	84.4	0.30	0.007	0.19	0.002

1. Summary of the Equation Results for the CBPRE and TSTM forecasts. The results of all the chosen equations are summarized in Table 21. The MJS CBPRE 12Z equation S.S. vary only slightly on the dependent and independent data samples. The 1970-83 percent correct is 81.3. The E.E. of the independent data frequencies are relatively small and vary little for the two independent data samples. Equation 31 can be used to forecast probabilities greater than 90 percent 15 percent of the time. The MJS 00Z equation 11 has higher skill scores and percent correct but the E.E. values are higher. There does not appear to be enough improvement to justify forecasting the 00Z RAOB except during a period of synoptic change.

The JJA 12Z CBPRE equation 27 S.S. vary appreciably for the different data periods (1970-78, 1979-81 and 1982-83). The E.E. for the two independent data periods are reasonably small. For 8.9 percent of the sample, the equation 27 results indicate that it is possible to make forecasts with an expected

Table 21. Comparative Evaluation of All the CBPRE and TSTM Equations.

RAOB Time	Eqn	% Reduc Var	First Pred	% Reduc Var	Skill Score 70-78	Skill Score 79-81	Skill Score 82-83	Skill Score 70-83	% Corr 70-83	(No Fcst)/(No Obs)	Freq Compar r 79-81	Freq Compar r 82-83	Freq Compar E.E. 79-81	Freq Compar E.E. 82-83	Freq Compar B.S.S. 79-81	Freq Compar B.S.S. 82-83	High and Low Prob Fcsts % Prob Zero	For R	% Prob <5	For R	% Prob >90	For R
CBPRE MJS																						
12Z	30	44.5	LINWS	32.1	0.63	0.64	0.57	0.63	81.3	0.950	0.97	0.97	0.21	0.19	0.013	0.008	0.0	-	0.0	-	12.1	>0.89
12Z	31	40.1	LINWS	28.6	0.63	0.64	0.59	0.63	81.3	1.023	0.98	0.96	0.23	0.21	0.008	0.009	0.0	-	0.0	-	15.0	>0.89
00Z	34	50.2	RH4	37.9	0.73	0.71	0.59	0.71	85.6	1.079	0.99	0.97	0.27	0.20	0.025	0.017	15.7	<0.1	23.6	<0.2	11.1	>0.99
00Z	11	46.1	RH4	35.8	0.70	0.73	0.73	0.71	85.7	0.928	0.98	0.97	0.36	0.29	0.019	0.018	9.9	<0.0	27.1	<0.2	5.4	>0.99
JJA																						
12Z	27	42.8	RH4	33.1	0.62	0.52	0.41	0.57	78.8	1.057	0.94	0.93	0.29	0.27	0.016	0.015	0.0	-	0.0	-	8.9	>0.99
12Z	16	39.1	RH4	29.3	0.56	0.47	0.46	0.53	76.7	1.042	0.97	0.95	0.25	0.29	0.015	0.016	2.1	<0.0	2.1	<0.0	8.5	>0.89
00Z	33	47.6	RH4	39.9	0.65	0.63	0.63	0.64	82.7	0.942	0.98	0.98	0.13	0.49	0.008	0.028	8.8	<0.0	16.3	<0.1	0.0	-
00Z	11	46.1	RH4	35.8	0.60	0.61	0.64	0.61	81.5	0.825	0.96	0.97	0.15	0.21	0.011	0.015	0.0	-	21.5	<0.1	0.0	-
TSTM MJS																	% Prob Zero	For R	% Prob <5	For R		
12Z	37	21.2	DEP40	11.6	0.34	0.33	0.19	0.31	78.1	1.442	0.82	0.96	0.36	0.14	0.018	0.001	0.0	-	9.7	<0.0		
12Z	44	20.9	TD70	14.3	0.49	0.25	0.27	0.39	82.9	1.104	0.92	0.96	0.28	0.24	0.009	0.009	5.9	<-0.075	11.1	<0.0		
00Z	21	23.9	KTOT	14.5	0.26	0.57	0.16	0.32	82.1	1.250	0.98	0.98	0.28	0.15	0.024	0.014	21.0	< 0.100	42.7	<0.3		
00Z	45	24.3	PW	16.6	0.43	0.38	0.26	0.39	85.4	1.043	0.95	0.89	0.27	0.69	0.017	0.050	0.0	-	42.9	<0.1		
JJA																						
12Z	41	25.1	DEP40	13.4	0.44	0.37	0.26	0.40	80.3	1.158	0.96	0.99	0.35	0.19	0.026	0.012	0.0	-	0.0	-		
12Z	46	27.6	RH4	23.7	0.51	0.43	0.26	0.45	81.7	1.223	0.97	0.93	0.19	0.40	0.012	0.024	1.1	<-0.172	38.2	<0.10		
00Z	36	23.5	PW	17.6	0.45	0.50	0.45	0.47	84.1	1.092	0.98	0.97	0.32	0.20	0.022	0.016	8.9	< 0.100	27.0	<0.30		
00Z	47	27.5	RH4	22.0	0.46	0.51	0.44	0.48	84.4	1.086	0.97	0.93	0.30	0.19	0.007	0.002	11.6	<-0.023	39.8	<0.10		

probability of better than 90 percent. The JJA 00Z equation skill scores are higher and much less variable than the 12Z values. The E.E. for the JJA equation 11 are smaller than the 12Z equation values and vary little for the 1979-81 and 1982-83 time periods. Equation 11 can be used to forecast probabilities less than five percent 21.5 percent of the time (R(11) < 0.1). The 00Z equation 33 can be used to forecast zero probabilities 8.8 percent of the time (for R(33) < 0.0), and probabilities less than five percent 16.3 percent of the time (R(33) < 0.1).

The MJS 12Z TSTM equation 44 S.S.s change in a manner that does not differ greatly from the best 00Z equation 45. The 1970-83 S.S. (0.39) is the highest MJS TSTM value. The frequency E.E. for equation 44 are relatively small and vary only slightly for the two independent data periods. Equation 44 R values less than -0.075 can be used to forecast zero probabilities of occurence. This is true 5.9 percent of the time. The 00Z equation 21 is exceptional in its ability to forecast low MJS TSTM probabilities. Twenty-one percent of the time (when R(21) < 0.1) there are no occurences. If R(21) is less than 0.3 (42.7 percent of the time) the probability of occurence is less than five percent. If 00Z R(45) is less than 0.1 probabilities of less than five percent can be forecast (true 42.9 percent of the time).

The JJA 12Z TSTM equation S.S.s are slightly higher than the MJS values. The 12Z equation E.E. vary appreciably on the independent data (0.35 and 0.19 for equation 41 and 0.19 and 0.40 for equation 46). The 12Z equation 46 can be used to forecast zero probability 1.1 percent of the time (for R(44) < -0.075) and probabilities less than five percent 28.3 percent of the time (for R(44) < 0.05). The 00Z equation skill scores are higher and vary less than 12Z ones on the independent data. The equation 47 E.E. are smallest (0.30 and 0.19) and vary less than the values for the 12Z equations. Equation 47 can be used to forecast zero probability 11.6 percent of the time (R(47) < -0.023) and probabilities less than five percent 39.8 percent of the time (R(47) < 0.010). These facts and the higher percent correct of the afternoon equations make it desirable to forecast the 00Z JJA RAOB.

m. <u>The Use of Single Predictors to Forecast Cumulonimbus or Precipitation.</u> Forecasters often use relevant predictors one at a time to form a judgement of CB occurence probability. These predictors can be mathematically treated to obtain an equation (see Tables D.6 and D.7 for sample CBPRE and TSTM single predictor equations). They can also be used to form classes of occurence probability. For instance RH4 values from 0 to 100 can be broken into ten classes with a range of 10 percent each. The number of occurences divided by the total in each class is the frequency of occurence. The frequency tables (Tables C.1 through C.44) can be used to determine the optimum basis of calculating skill scores. For instance, for RH4, it can be seen from the Table C.7 frequency column that the greatest skill would result from using an RH4 value of 40.0 or more as a basis of forecasting yes. The frequency table analysis technique was used to relate CBPRE occurence to all the predictors. The results for the best predictors are summarized in Table 22. The dependent data years used were 1970-78. The independent data years were 1979-83. From Table 22, it can be seen that the best predictor for all periods and times was RH4. The percent reduction in variance due to RH4 varied from a minimum of 32.3 percent (r = 0.57) for MJS 12Z to a maximum of 42.9

Table 22. Comparison of Regression Equation Results for Cumulonimbus or Precipitation to the Results of the Best Predictors for Each Time Period.

	1970-78		1979-83		1970-83		% Reduc Var	Freq Compar for 1970-78 & 1979-83	
	S.S.	% Corr	S.S.	% Corr	S.S.	% Corr		(r)	(E.E.)
May - June 14 and September Scores for Best Equation and the Best Predictors.									
Radiosonde Observation Time 12Z									
Eqn 30	0.630	81.6	0.618	80.9	0.630	81.4	44.5	0.984	0.094
K (>17.4)	0.502	75.3	0.530	76.7	0.512	75.8	28.6	0.982	0.162
LI[a] (<6)	0.529	76.5	0.494	74.6	0.518	75.9	32.1	0.958	0.137
PW (>0.44)	0.352	67.9	0.353	67.9	0.357	67.9	18.7	0.945	0.140
RH4 (>39)	0.530	76.5	0.550	77.8	0.541	77.0	32.3	0.980	0.096
TOT (>25)	0.521	76.0	0.508	75.6	0.519	75.9	29.1	0.962	0.219
Radiosonde Observation Time 00Z									
Eqn 34	0.734	86.9	0.667	83.2	0.710	85.6	50.2	0.986	0.161
K (>22.4)	0.313	75.0	0.527	76.3	0.498	75.4	31.4	0.979	0.334
LI (<2.1)	0.410	73.0	0.322	65.4	0.409	70.0	18.5	0.822	0.301
PW (>0.44)	0.361	68.9	0.305	64.8	0.344	67.5	17.9	0.959	0.178
RH4 (>39)	0.604	80.7	0.613	80.7	0.609	80.9	42.9	0.965	0.237
SD (<18.0)	0.398	71.6	0.508	75.7	0.439	73.0	23.0	0.970	0.217
TOT (>26)	0.587	79.6	0.384	69.0	0.517	75.9	33.5	0.948	0.263
June 15 - August 31 Scores for Best Equation and the Best Predictors.									
Radiosonde Observation Time 12Z									
Eqn 27	0.618	81.1	0.489	74.5	0.573	78.8	42.8	0.962	0.266
K (>19)	0.434	72.1	0.278	63.8	0.381	69.2	25.6	0.926	0.240
LI (<4)	0.462	73.4	0.207	60.9	0.364	69.0	26.2	0.808	0.310
PW (>0.59)	0.449	73.1	0.447	72.3	0.452	72.8	27.7	0.976	0.140
RH4 (>44)	0.539	78.1	0.427	71.5	0.500	75.8	33.1	0.985	0.140
TOT (>26)	0.401	70.1	0.416	70.7	0.407	70.3	19.2	0.972	0.173
Radiosonde Observation Time 00Z									
Eqn 33	0.650	83.3	0.630	81.7	0.640	82.7	47.6	0.988	0.189
K (>22.4)	0.524	76.5	0.513	75.2	0.523	76.0	31.9	0.972	0.432
PW (>0.59)	0.499	76.2	0.565	78.2	0.526	76.9	30.8	0.957	0.415
RH4 (>34)	0.595	80.8	0.625	81.4	0.608	81.0	39.9	0.992	0.156
SD (<22.6)	0.398	72.2	0.338	67.4	0.379	70.5	22.0	0.946	0.253
TOT (>27)	0.407	72.2	0.549	77.6	0.442	74.1	23.7	0.912	0.604

[a]Abbreviation for LINWS.

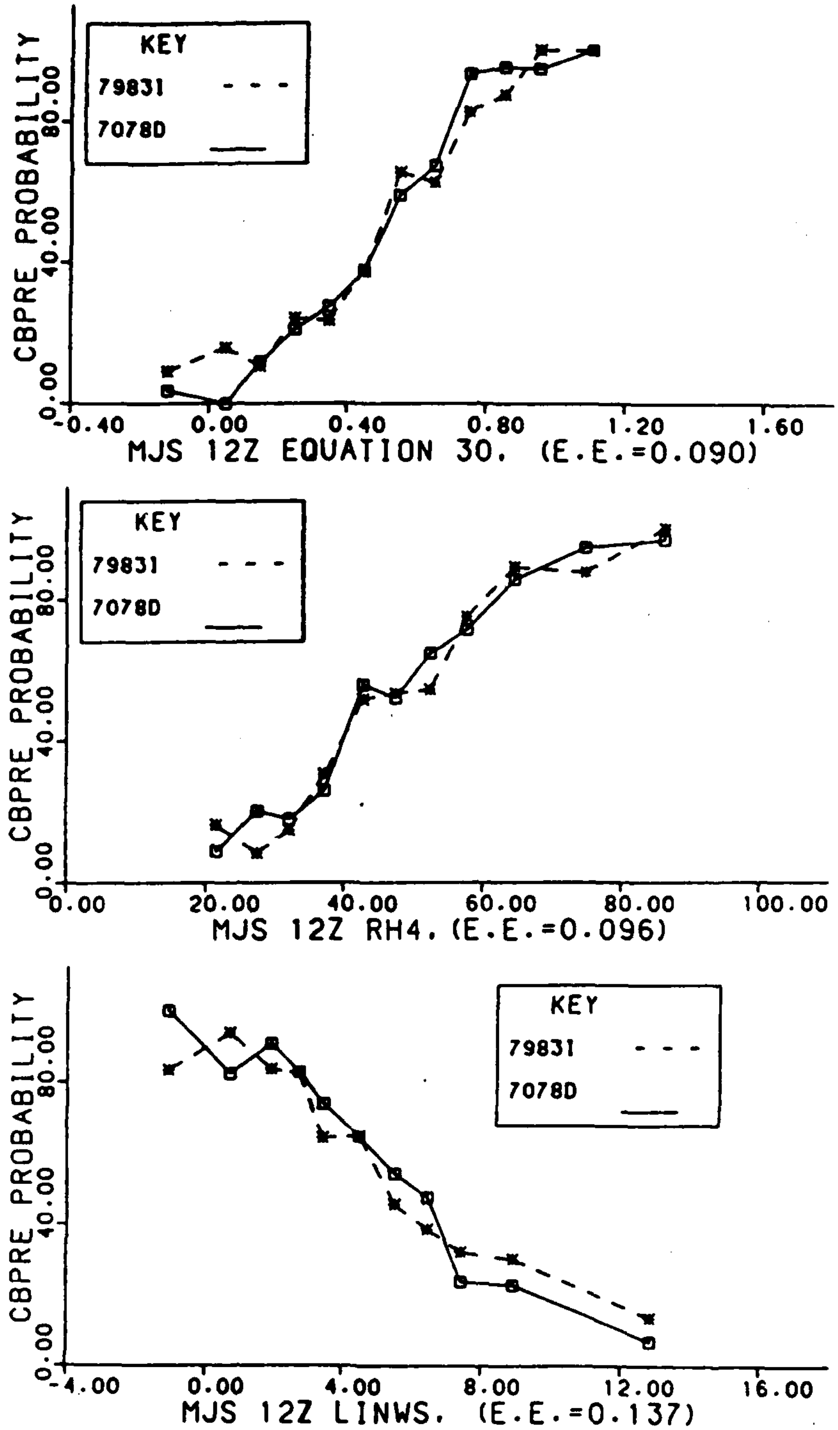

Figure 1. MJS Equation 30, RH4, and LINWS Probability Comparisons for Dependent Data (D) and Independent Data (I).

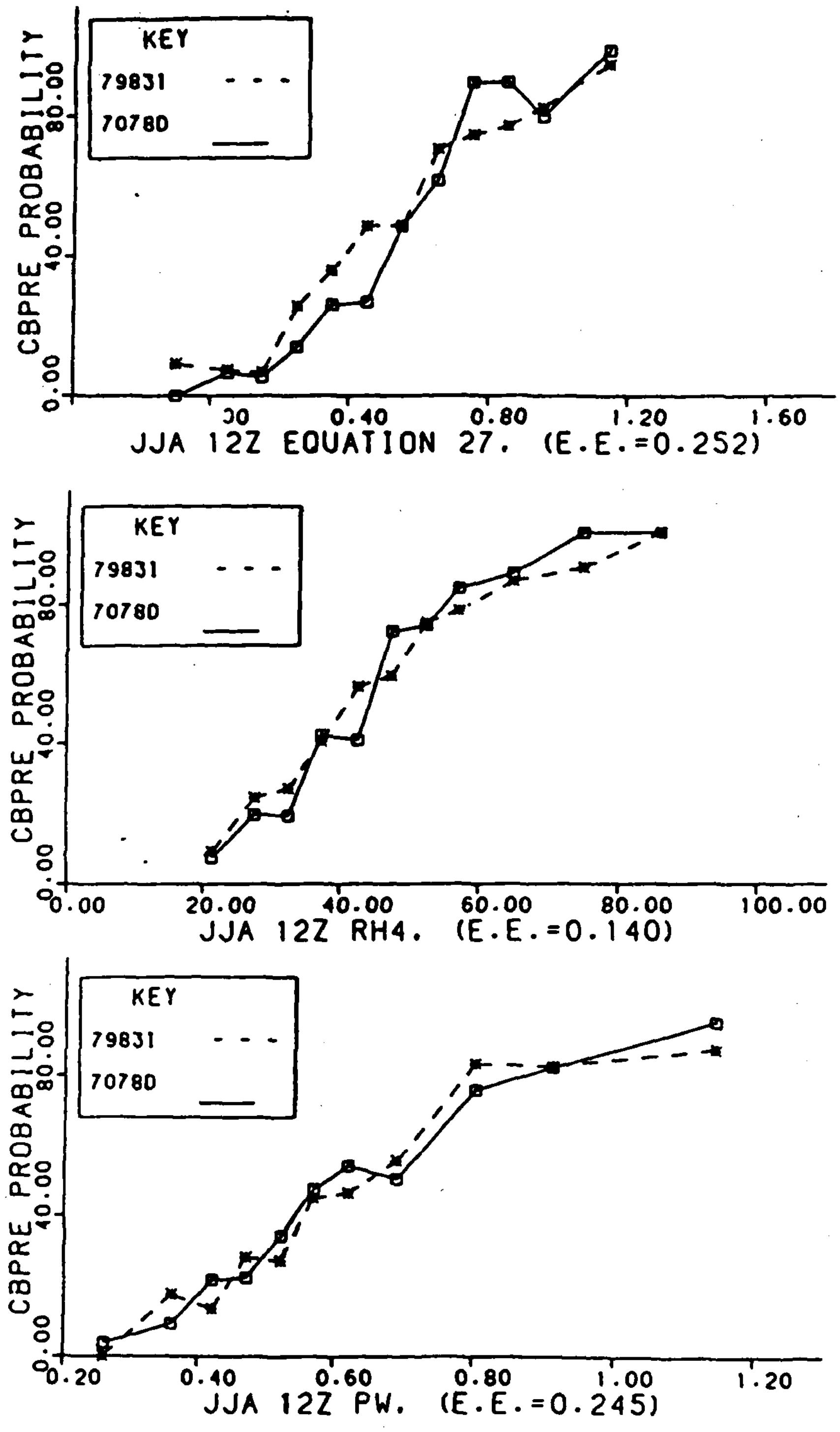

Figure 2. JJA Equation 27, RH4, and PW Probability Comparisons for Dependent Data (D) and Independent Data (I).

percent (r = 0.65) for MJS 00Z. The average RH4 12Z skill score and percent correct for May through September 1970-83 were 0.54 and 77.0 compared to 0.63 and 81.4 for the best equation. No other single predictor consistently yields greater S.S. and percent correct. Another point in favor of RH4 is that the E.E. between 1970-78 and 1979-83 frequencies is almost as small as the value for the best MJS 12Z equation and smaller than the best JJA 12Z equation value. Figures 1 and 2 make it possible to visually compare the dependent and independent data curves of frequency plotted against R values and relate a subjective visual evaluation to the calculated E.E. The two lowest E.E. are 0.090 for MJS CBPRE R(30) and 0.096 for MJS CBPRE RH4. A contingency table for RH4 can be prepared by combining 1970-78 and 1979-83 MJS CBPRE frequency tables (C.7 and C.8). The RH4 MJS 12Z contingency table (Table 23 a.) based on RH4 values of 40 or more show a tendency to overforecast by 12 to 16 percent. This compares to MJS equation 30 which underforecasts by 4.7 percent (Table A.13). From Table 23 b., it can be seen that if the basis of a yes forecast were 45 or more, the number forecast and observed would be almost equal, but the overall skill score and percent correct would drop slightly.

Table 23. RH4 1970-83 12Z CBPRE Contingency Tables.

a. Forecast Yes for RH4 > 39		Observed			b. Forecast Yes for RH4 > 44	Observed	
		Yes	No	Total	Yes	No	Total
F	Yes	403	150	553	364	117	481
C							
S	No	83	376	459	122	409	531
T							
	Total	486	526	1012	486	526	1012
S.S. = 0.541	% Correct = 77.0				S.S. = 0.527	% Correct = 76.4	

In table 22 above, neither the MJS or JJA single predictor E.E. values improve when the 00Z RAOB data are used. For MJS RH4 and all the JJA predictors, the 00Z skill scores and percent correct do improve. This compares to the MJS 00Z equation 34 for which the E.E. of 0.205 is greater than the 0.094 value for the 12Z equation 30 and the JJA equation 33 for which the E.E. of 0.189 is less than the JJA 12Z equation 27 value of 0.266. A surprising detail is the performance of LINWS. It does better for the MJS 12Z than for the 00Z data and is ranked as second best predictor for the 12Z period. It does poorly using either the 12Z or 00Z JJA data. The popular K index does best using the JJA 00Z RAOB data but is still no better than third best predictor on a comparative S.S. and percent correct basis.

n. <u>The Use of MJS single Predictors to Forecast Thunder.</u> The predictor frequency tables used as the basis of the analysis in this section and the next one are Tables C.45 through C.64 for MJS and C.65 through C.84 for JJA. A summary of the comparative performance of the best TSTM predictors and the two best equations for each time period are shown in Table 24. The equations and

Table 24. Comparison of Regression Equation Results for Thunder to the Results of the Best Predictors for Each Time Period.

	1970-78		1979-83		1970-83		% Reduc Var	Freq Compar for 1970-78 & 1979-83	
	S.S.	% Corr	S.S.	% Corr	S.S.	% Corr		(r)	(E.E.)
May - June 14 and September Scores for Best Two Equations and the Best Predictors.									
Radiosonde Observation Time 12Z									
Eqn 37	0.34	79.5	0.27	77.6	0.31	78.1	21.2	0.944	0.253
Eqn 44	0.49	87.6	0.26	75.6	0.39	82.9	20.9	0.966	0.256
K (>27.4)	0.31	81.7	0.22	71.7	0.28	78.2	14.0	0.970	0.240
LINWS (<3.0)	0.28	79.7	0.29	73.1	0.29	77.4	11.5	0.837	0.322
PW (>0.59)	0.36	81.4	0.25	70.6	0.31	77.6	13.4	0.985	0.382
TOT (>29.9)	0.36	78.8	0.27	70.9	0.33	76.0	10.7	0.984	0.434
Radiosonde Observation Time 00Z									
Eqn 21	0.26	81.7	0.41	83.0	0.32	82.1	23.9	0.990	0.386
Eqn 45	0.43	87.5	0.33	81.3	0.39	85.4	24.3	0.984	0.566
K (>24.9)	0.38	81.1	0.20	64.3	0.30	75.2	14.3	0.936	0.563
PW (>0.54)	0.37	81.1	0.21	67.9	0.30	76.5	16.6	0.918	0.623
RH4 (>49.9)	0.33	80.1	0.26	72.1	0.30	77.3	15.2	0.928	0.350
June 15 - August 31 Scores for the Best Two Equations and the Best Predictors.									
Radiosonde Observation Time 12Z									
Eqn 41	0.44	83.1	0.33	75.0	0.40	80.3	25.1	0.993	0.186
Eqn 46	0.51	84.4	0.36	76.6	0.45	81.7	27.6	0.961	0.267
K (>27.4)	0.39	81.7	0.33	76.3	0.37	79.7	16.2	0.979	0.191
PW (>0.79)	0.40	82.8	0.36	78.5	0.39	80.9	21.0	0.994	0.111
RH4 (>54.9)	0.42	83.3	0.33	79.0	0.39	81.8	23.7	0.986	0.174
Radiosonde Observation Time 00Z									
Eqn 36	0.45	85.4	0.49	81.7	0.47	84.1	23.5	0.993	0.308
Eqn 47	0.46	86.0	0.49	81.4	0.48	84.4	27.5	0.974	0.234
K (>27.4)	0.39	82.3	0.39	74.7	0.39	79.6	15.5	0.976	0.407
PW (>0.79)	0.41	85.6	0.41	80.1	0.42	83.6	21.2	0.957	0.317
RH4 (>49.9)	0.39	85.3	0.42	81.4	0.40	83.9	22.0	0.967	0.170

predictors can be rated for S.S. and percent correct on dependent and independent data and for E.E. between the dependent and independent data frequencies. For 12Z MJS the best 1970-83 predictor S.S. and percent correct results (K index 0.28 and 78.2) approximately equal the results for the 12Z equation 37 (0.31 and 78.1) but are less good than those for equation 44 (0.39 and 82.9). The MJS 12Z E.E. value for K is 0.240 for the 1979-83 period compared to 0.253 for equation 37. Performance can also be rated separately for ability to correctly forecast a low probability, for ability to forecast yes correctly and for the ability to forecast no correctly. Table 25 summarizes the basis of this kind of comparison for MJS 12Z data. The frequency of occurence of TSTM in the MJS period is 16.1 percent. If it were possible to forecast a probability of occurence of less than five percent, it would be an improvement over the climatological probability. In Table 25, the best low probability results (less than five percent) are for equation 44, where, if R(44) is less than 0.12, the probability of TSTM occurence is always less than five percent, true for 41.7 percent of the whole sample. The best predictor results (LINWS > 7.9) produce probabilities less than five percent 34.5 percent of the time. For the ability to forecast yes correctly, equation 37 is best on independent data (37.3 percent corect), equation 44 is second (34.9 percent correct) and LINWS is third (34.2 percent correct). For all the 1970-83 data and the ability to forecast yes correctly, equation 44 is first (47.2 percent correct), equation 37 is second (37.4 percent correct) and PW is third (37.1 percent correct).

Table 25. Percent of Time MJS 12Z TSTM Predictors or Equations Are Correct.

Eqn or Indepen-dent Var	Percent of Probabilities <5 % for Indicated Yrs			Lower Limit	Percent of Correct Yes Fcsts for Indicated Yrs			Upper Limit	Percent of Correct No Fcsts for Indicated Yrs		
	1970-78	1979-83	1970-83		1970-78	1979-83	1970-83		1970-78	1979-83	1970-83
37(R<0.1)	13.5	16.6	14.6	(>0.59)	37.5	37.3	37.4	(<0.60)	92.2	88.1	90.3
44(R<0.12)	44.7	36.3	41.7	(>0.34)	58.5	34.9	47.2	(<0.35)	92.3	88.4	90.6
K(<10.0)	26.4	16.6	22.9	(>27.4)	41.3	31.1	36.2	(<27.5)	89.4	88.6	89.2
PW(<0.30)	18.0	10.0	15.1	(>0.59)	42.1	32.0	37.1	(<0.60)	90.9	90.4	90.7
TOT(<20.0)	22.1	18.6	20.9	(>29.9)	38.9	32.8	36.3	(<30.0)	92.6	91.1	92.1
LI[a](>7.9)	36.8	30.2	34.5	(<3.0)	37.2	34.2	35.8	(>2.9)	92.2	90.4	89.7
RH4(<30.0)	26.5	21.9	24.9	(>59.9)	38.0	27.4	33.2	(<60.0)	90.0	87.1	89.1

[a]Abbreviation for LINWS.

For the ability to forecast no correctly, TOT is best on independent data (91.1 percent correct), LINWS and PW are second (90.4 percent correct), and K is third (88.6 percent correct). For 1970-83, TOT (92.1 percent) and PW (90.7 percent) are still first and second. Equation 44 (90.6 percent) and equation 37 (90.3 percent) are third and fourth.

The optimum MJS 12Z TSTM forecast procedure is to inspect the results for the equations and predictors. Choose the one having the qualities desired and stick with it. Equation 44 produces the maximum confidence forecasts for

Table A.5. Equation 30 Frequency Table for MJS 1979-81.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.070	0	9	0.000	4.2		
0.0 - 0.1	0.050	1	12	0.083	5.6	0.048	9.8
0.1 - 0.2	0.147	2	24	0.083	11.2		
0.2 - 0.3	0.251	5	23	0.217	10.7	0.149	22.0
0.3 - 0.4	0.347	5	21	0.238	9.8		
0.4 - 0.5	0.449	6	24	0.250	11.2	0.244	21.0
0.5 - 0.6	0.543	9	13	0.692	6.1		
0.6 - 0.7	0.646	8	15	0.533	7.0	0.607	13.1
0.7 - 0.8	0.735	13	18	0.722	8.4		
0.8 - 0.9	0.845	18	21	0.857	9.8	0.795	18.2
0.9 - 1.0	0.946	16	16	1.000	7.5		
1.0 - 3.0	1.094	18	18	1.000	8.4	1.000	15.9
(-1.0) - 3.0	0.514	101	214	0.472		0.472	

Table A.4. Equations 30 and 31 12Z Radiosonde Cumulonimbus or Precipitation Contingency Tables for May 1 to June 14 and September.

CONTINGENCY TABLE

MONTH: MJS YEARS: 1979-81 LOCATION: KSLC

EQUATION: 30 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	82	19	101
C S	NO	19	94	113
T	TOTAL	101	113	214

E: 107.3 SS: 0.644 CORRECT: 82.2 %

EQUATION: 31 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	84	22	106
C S	NO	17	91	108
T	TOTAL	101	113	214

E: 107.1 SS: 0.635 CORRECT: 81.8 %

Table A.3. Equation 31 Frequency Table for MJS 1970-78.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.121	2	50	0.040	7.7		
0.0 - 0.1	0.057	0	40	0.000	6.1	0.022	13.8
0.1 - 0.2	0.149	3	60	0.050	9.2		
0.2 - 0.3	0.243	12	49	0.245	7.5	0.138	16.7
0.3 - 0.4	0.354	19	81	0.235	12.4		
0.4 - 0.5	0.448	21	67	0.313	10.3	0.270	22.7
0.5 - 0.6	0.550	36	67	0.537	10.3		
0.6 - 0.7	0.647	35	54	0.648	8.3	0.587	18.6
0.7 - 0.8	0.741	50	60	0.833	9.2		
0.8 - 0.9	0.853	38	40	0.950	6.1	0.880	15.4
0.9 - 1.0	0.937	47	49	0.959	7.5		
1.0 - 3.0	1.102	34	34	1.000	5.2	0.976	12.7
(-1.0) - 3.0	0.475	297	651	0.456		0.456	

Table A.2. Equation 30 Frequency Table for MJS 1970-78.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.106	2	56	0.036	8.6		
0.0 - 0.1	0.058	0	49	0.000	7.5	0.019	16.1
0.1 - 0.2	0.147	7	60	0.117	9.2		
0.2 - 0.3	0.250	12	57	0.211	8.8	0.162	18.0
0.3 - 0.4	0.350	23	84	0.274	12.9		
0.4 - 0.5	0.450	24	64	0.375	9.8	0.318	22.7
0.5 - 0.6	0.545	33	57	0.579	8.8		
0.6 - 0.7	0.649	45	65	0.692	10.0	0.639	18.7
0.7 - 0.8	0.751	41	45	0.911	6.9		
0.8 - 0.9	0.850	44	46	0.957	7.1	0.934	14.0
0.9 - 1.0	0.946	32	34	0.941	5.2		
1.0 - 3.0	1.098	34	34	1.000	5.2	0.971	10.4
(-1.0) - 3.0	0.451	297	651	0.456		0.456	

Table A.1. Equations 30 and 31 12Z Radiosonde Cumulonimbus or Precipitation Contingency Tables for May 1 to June 14 and September.

CONTINGENCY TABLE

MONTH: MJS YEARS: 1970-78 LOCATION: KSLC

EQUATION: 30 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	229	52	281
C				
	NO	68	302	370
S				
T	TOTAL	297	354	651

E: 329.4 SS: 0.627 CORRECT: 81.6 %

EQUATION: 31 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	240	64	304
C				
	NO	57	290	347
S				
T	TOTAL	297	354	651

E: 327.4 SS: 0.626 CORRECT: 81.4 %

APPENDIX A

CUMULONIMBUS OR PRECIPITATION CONTINGENCY FORECAST TABLES AND PROBABILITY TABLES

higher than the 12Z RAOB equation values. The E.E. does not improve. The percent of low probability cases for the best 00Z RAOB equation is 1.3 times the best 12Z equation value.

An inspection of the change in equation predictor coefficients with each additional BMDP2R step shows the relationship to the correlation between predictors. It is possible that some of the equations would behave more consistently on dependent and independent data if one of each pair of highly correlated predictors was dropped.

6. CONCLUSIONS. The NWS numerical models are not capable of making timely accurate forecasts of the probability of thunderstorm occurence. The use of statistical analysis of relevant predictors makes is possible to produce equations with which one can make reasonably accurate forecasts. The 12Z radiosonde equation results can be used to forecast yes or no occurence for CBPRE or TSTM for the period 0600 to 2400 MST. Probability forecasts can also be made with high confidence for CBPRE and with less high confidence for TSTM. Effective use can be made of a high-confidence forecast of the times when thunder is least likely to occur. Thunder can be predicted to occur less than five percent of the time for 42 percent of the MJS cases and 30 percent of the JJA cases. An accurate forecast of the 00Z JJA RAOB would increase the ability to make less than five percent JJA TSTM probability forecasts.

7. RECOMMENDATIONS. No effort was made in this study to reduce the number of predictors in an equation because they are highly correlated. Neter, Wasserman, and Kutner (Reference 25) outline methods of improving regression equations when the independent variables are highly correlated (multicollinearity). They recommend the use of ridge regression. Ridge regression can be used to remedy multicollinearity problems by modifying the method of least squares to allow biased estimators of the regression coefficients. Also, expressing the independent variables as deviations from the mean substantially reduces multicollinearity. Further, outlying observations can be identified and screened out to see whether they lead to serious distortion of the regression equation. The authors suggest the use of the method of least absolute deviations. This method is robust and has the property of being insensitive to both outlying data values and inadequacies of the model employed. Neter, et al, also recommend an article by Hogg (Reference 26) in which he discusses several proposed robust procedures designed to deal with the problems of multicollinearity. Experimentation with some of these methods could lead to significant improvement of the regression equation performance. Mesoscale modelling output, including calculations of local divergence or convergence should produce additional useful predictors for statistical analysis.

12Z SLC RAOB was used to make morning probability forecasts of CBPRE occurence and to prepare a yes or no forecast. The verification period is 0600 MST to 2400 MST using the 12Z radiosonde and 1200 MST to 2400 MST using the 00Z radiosonde. This study is based on observed data. In practice the 00Z radiosonde would have to be forecast in order to use it in the morning. The best MJS (spring and fall) CBPRE 12Z equation 30 was based on 1970-78 dependent data and obtained an independent data (1979-83) skill score and percent correct of 0.62 and 80.9. The overall (1970-83) scores were 0.63 and 81.3. The probability forecast estimated errors (E.E.) were 0.21 and 0.19 for two independent data sets; 1979-81 and 1982-83. If the two independent data sets are combined into one five year set, the probability E.E. is 0.094. The 00Z MJS equation 34 1979-83 skill score increased over the 12Z value from 0.62 to 0.67. The percent correct increased from 80.9 to 83.2. The 00Z RAOB equation probability E.E. does not improve. The best 12Z MJS predictor, RH4 produces an independent data skill score of 0.55 and a percent correct of 77.8. The probability E.E. between the dependent data and the five year independent data set is 0.096.

For the JJA (summer) period, the best 12Z CBPRE equation obtained a five year independent data S.S. of 0.49 and a percent correct of 74.5. The probability E.E. are 0.29 and 0.27 on two independent data sets. The E.E. for the five year independent data set was 0.252. The best JJA 00Z equation obtained a five year independent data skill score of 0.63 and a percent correct of 81.7. The E.E. on the two independent data sets were 0.13 and 0.49. The E.E. was 0.19 on the combined five year data set. The best overall JJA 12Z CBPRE predictor RH4 had a 1979-83 skill score of 0.43 and a percent correct of 71.5. The probability E.E. for the five year independent data period was 0.14. PW also had a 1979-83 E.E. of 0.14, a S.S. of 0.45 and a percent correct of 72.3 but the 1970-83 S.S. and percent correct were less than for RH4.

The best MJS 12Z TSTM equation had a 1970-83 skill score of 0.39 and a percent correct of 82.9. The probability E.E. for the 1979-83 independent data was 0.26. The best predictor, K had a 1970-83 S.S. of 0.28 and a percent correct of 78.2. The probability E.E. was 0.24 for 1979-83. The MJS equation can be used to forecast a less than five percent probability 42 percent of the time. The best low probability predictor, LINWS is associated with less than five percent probability 35 percent of the time.

The MJS 00Z RAOB TSTM equation 1970-83 skill score does not differ from the 12Z equation values. The percent correct improves 2.5 percent. The probability E.E. is worse (higher). The skill score, percent correct, and E.E. of the best 00Z RAOB predictor do not improve.

The JJA 12Z TSTM equation 46 performs slightly better than the MJS 12Z equation 37 on 1970-83 data. The JJA 12Z equation 41 has a better probability E.E. The JJA equation 46 percent of low probability forecasts for 1970-83 is smaller, 18.3 percent. The best JJA predictor RH4 is better than the best JJA 12Z equation in overall percent correct, but the S.S. is lower. The RH4 E.E. is better than that of the best equation. PW, with similar skill scores and percent correct, also has a small probability E.E.

The JJA 00Z RAOB TSTM equations 1970-83 S.S. and percent correct are both

Table 30. Comparison of Two Kinds of Thunder Equations.

Percent of Variance Explained by Four Thunder Equations Based on Data for which the Distribution is 50-50 Thunder and No Thunder.

Var No	1	2	3	4	5	6	7	8	9	10	11	
Var Name	DEP40	V7	TD70	TD85	POSAR	H85	VSUR	USUR	UII	PW		Total
Eqn 37	11.64	2.72	1.81	0.84	1.85	0.96	0.17	0.84	0.07	0.29		21.19
Var Name	KTOT	DEP50	V5	U7	TD40							
Eqn 21	14.52	4.64	2.76	1.35	0.62							23.89
Var Name	DEP40	PW	TOT	K	H85	USUR	SURP	V7	TD85	U7	POSAR	
Eqn 41	13.42	5.20	1.93	1.53	0.98	0.64	0.54	0.39	0.30	0.20	0.03	25.14
Var Name	PW	H70	USUR	TOT								
Eqn 36	17.58	3.34	1.79	0.79								23.50

Eqn No	37		21		41		36	
	S.S.	% Corr	S.S.	% Corr	S.S.	% Corr	S.S.	% Corr
70-78	0.34	79.5	0.26	81.7	0.44	83.1	0.45	85.4
79-81	0.33	79.9	0.57	87.4	0.37	79.3	0.50	85.5
82-83	0.19	74.1	0.16	76.3	0.26	68.5	0.45	75.5
79-83	0.27	77.6	0.41	83.0	0.33	75.0	0.49	81.6
70-83	0.31	78.1	0.32	82.1	0.40	80.3	0.47	84.1

Percent of Variance Explained by Four Thunder Equations Based on All the 1970-78 Data for MJS and JJA.

Var No	1	2	3	4	5	6	7	8	9	Total
Var Name	TD70	RH4	POSAR	USUR	TD85	U7	H85	TOT		
Eqn 44	14.32	2.50	1.62	1.15	0.35	0.33	0.52	0.091		20.89
Var Name	PW	SURT	LINWS	USUR	DEP85	TOT	TD40			
Eqn 45	16.55	3.43	2.39	0.95	0.67	0.23	0.06			24.28
Var Name	RH4	PW	DEP40	V7	USUR	U7	K	POSAR	TD85	
Eqn 46	23.66	1.13	0.99	1.02	0.28	0.23	0.05	0.13	0.08	27.58
Var Name	RH4	PW	SURT	DEP85	LINWS	USUR	POSAR			
Eqn 47	21.98	2.10	1.53	0.72	0.78	0.20	0.14			27.46

Eqn No	44		45		46		47	
	S.S.	% Corr	S.S.	% Corr	S.S.	% Corr	S.S.	% Corr
70-78	0.49	87.6	0.43	87.5	0.51	84.4	0.46	86.0
79-81	0.25	75.7	0.38	81.8	0.43	82.8	0.51	85.5
82-83	0.27	75.5	0.26	80.6	0.26	67.1	0.44	74.8
79-83	0.26	75.6	0.33	81.3	0.36	76.6	0.49	81.4
70-83	0.39	82.9	0.39	85.4	0.45	81.7	0.48	84.4

5. SUMMARY OF RESULTS. The BMDP2R stepwise regression program was used to analyze 1970-83 SLC data and select the eight best equations to forecast Cumulonimbus clouds or precipitation at the SLC airport station. The observed

Table 29. Percent of Reduction in Variance on the Dependent Data for the Cumulonimbus-or-Precipitation Equations.

Var. No.	1	2	3	4	5	6	7	8	9	10	11	12	13	
70-78 MJS 12Z equation number 30, 691 cases, average CBPRE occurence 45.2%.														
Var. Name	LINWS	RH4	V7	UII	V5	U5	SURDEP							Total
%	32.13	7.35	3.13	0.62	0.55	0.41	0.29							44.47
70-78 MJS 12Z equation number 31, 566 cases, average CBPRE occurence 53.5%.														
Var. Name	LINWS	RH4	V5	UI	SURDEP	U5	KTOT	V7	UII					
%	28.62	6.16	3.25	0.74	0.46	0.48	0.14	0.08	0.06					40.06
70-78 MJS 00Z equation number 34, 541 cases, average CBPRE occurence 52.9%.														
Var. Name	RH4	VSUR	H85	SURDEP	U5	V7	V5	UII	KTOT	K	T85	T50	CONVI	
%	37.90	9.32	0.53	0.66	0.36	0.17	0.26	0.08	0.08	0.14	0.19	0.24	0.23	50.15
80-83 MJS 00Z equation number 11, 566 cases, average CBPRE occurence 47.4%.														
Var. Name	RH4	LINWS	VSUR	SURDEP	K	U5	H85	V7	PW	T50	T85	CONVI	V5	
%	35.80	5.02	1.90	0.55	0.40	0.23	0.30	0.29	0.40	0.26	0.73	0.33	0.16	46.09
70-78 JJA 12Z equation number 27, 688 cases, average CBPRE occurence 42.7%.														
Var. Name	RH4	SURT	U5	H85	POSAR	DEP40	LINWS	UII	DEP70	V5	VSUR			
%	33.11	5.66	0.92	1.00	0.69	0.70	0.11	0.24	0.11	0.10	0.06			42.75
80-83 JJA 12Z equation number 16, 574 cases, average CBPRE occurence 52.3%.														
Var. Name	RH4	U5	V5	TOT	SURT	SURTD	PW	LINWS	TD85	POSAR	UI	HD7085		
%	29.33	4.18	2.47	1.39	0.30	0.37	0.20	0.24	0.06	0.23	0.18	0.13		39.06
70-78 JJA 00Z equation number 33, 693 cases, average CBPRE occurence 41%.														
Var. Name	RH4	LINWS	SURDEP	T85	H85	VSUR	V7	CONVI	K					
%	39.85	2.87	0.61	1.39	0.85	0.34	0.79	0.19	0.55					47.56

80-83 JJA 00Z equation 11 same as MJS equation 11 above.

forecast. For this purpose equations 36 and 47 are best. Also the skill scores and percent correct for the equations are better than any of the predictor values. The RH4 E.E. is lowest (0.170) but the evaluation of all other bases of evaluation place Equation 47 as best, equation 36 second and RH4 third.

p. Percent Reduction of Variance Due to Each Equation Predictor. Tables 29 and 30 indicate the step-by-step reduction in variance for the different equation predictors. For instance, in the development of the 12Z MJS CBPRE equation 30, the first predictor LINWS reduced the variance 32.13 percent. The second predictor RH4 reduced the variance an additional 7.35 percent. For the 12Z JJA CBPRE equation 27, the first predictor RH4 reduced the variance 33.11 percent. The second, SURT, reduced it an additional 5.66 percent. For the 12Z MJS TSTM equation 44, the first predictor TD70 reduced the variance 14.3 percent and the second, RH4 reduced it an additional 2.5 percent. The first predictor RH4 for the 12Z TSTM JJA equation 46 reduced the variance 23.66 percent. The second, PW reduced it an additional 1.13 percent.

It is of interest that RH4, which produced an additional 7.35 percent reduction in variance for equation 30, if used alone on all the 1970-78 data, reduces the variance 32.3 percent (see Table 22). TOT and K index, used alone, also reduce the variance 29.1 and 28.6 percent respectively. The correlation coefficient between the first two equation 30 predictors LINWS and RH4 is -0.61 (Table D.2).

The second step for equations 30, 44 and 46 all resulted in a reduction of the first step predictor coefficient of more than 30 percent (see Tables D.2, D.4, and D.5). The correlations between the first and second predictors were -0.61, 0.61, and 0.81, respectively. For the JJA 12Z CBPRE equation 27, the second step (SURT) reduction of the first step (RH4) predictor coefficient was -9.8 percent (see Table D.3). The correlation between RH4 and SURT is 0.23. Ideally, the predictors should not be correlated. If they were not, the coefficients would not change as each new predictor is added. Tables D.2, D.3, D.4, and D.5 include the detail of the amount of coefficient change for all of the steps for each of the above equations. The correlations between the variables is also included. The relationship between coefficient change and correlation is not always as straightforward as the sample above.

used only when R(46) is not less than 0.07, the 1970-83 percent of occurence is 5.9 percent. As indicated for R(44) and LINWS above, the predictor probabilities must be used alone. They cannot be superimposed on the equation results. The final choice based on the above are equation 46 for first and RH4 for second.

The JJA 00Z RAOB data period frequency of TSTM occurence was 17.4 percent, 1.6 percent less than the 12Z RAOB data period. The 00Z equation 36 percent correct (81.7 percent) on independent data (Table 24) improves 2.7 percent over the best 12Z RAOB result of RH4 (79.0 percent). The second best 00Z data percent correct is 81.4 percent for both equation 47 and RH4. The equation skill scores are higher however (0.49 for both equations) compared to 0.42 for RH4. The 0.49 skill score is an improvement over the best 12Z independent data value of 0.36 (equation 46 and PW). Overall, equation 47 has the best skill score and percent correct. The equation 47 84.4 1970-83 percent correct is 2.3 percent better than the best 12Z result of RH4. The percent reduction in variance caused by equation 47 decreases 0.1 percent from the best morning value. The RH4 value decreases 1.7 percent. The 00Z RH4 E.E. value (0.170) improves and is better than the equation 47 value (0.234) which also improves. Detailed comparisons appear in Table 28. The equation 47 ability to make low

Table 28. Percent of Time JJA 00Z TSTM Predictors or Equations are Correct.

Eqn or Indepen-dent Var	Percent of Probabilities <5 % for Indicated Yrs 1970-78	1979-83	1970-83	Lower Limit	Percent of Correct Yes Fcsts for Indicated Yrs 1970-78	1979-83	1970-83	Upper Limit	Percent of Correct No Fcsts for Indicated Yrs 1970-78	1979-83	1970-83
36(<0.3)	40.1	28.0	35.9	(>0.59)	56.3	51.5	54.0	(<0.60)	90.5	92.6	91.2
47(<0.1)	45.5	29.1	39.8	(>0.34)	58.6	51.0	54.7	(<0.35)	90.6	92.9	91.3
RH4(<25.0)	31.7	21.6	28.2	(>49.9)	57.6	51.3	54.5	(<50.0)	88.8	89.4	89.0
PW(<0.4)	16.9	8.6	14.0	(>0.79)	58.3	48.3	53.2	(<0.80)	89.3	90.1	89.6
K(<15.0)	14.9	8.7	12.7	(>27.4)	46.6	41.5	44.0	(<27.5)	90.6	93.6	91.5
TOT(<20.0)	13.9	12.4	13.3	(>28.9)	36.0	33.8	35.0	(<29.0)	89.5	89.1	89.4
LI[a](>4.9)	9.2	10.5	9.7	(<0.0)	24.4	34.5	28.9	(>-0.1)	86.3	90.1	87.4

[a]Abbreviation for LINWS.

probability forecasts improves over the 12Z equation 46. The overall percent of 39.8 percent low probability cases if R(47) is less than 0.1 is 1.3 times the best (equation 46) 12Z value of 30.3. The RH4 00Z results are also better than the 12Z values with an overall RH4 less than five percent occurence percent of 28.2 (1.7 times better than the 12Z RH4 value of 16.6). There is very little choice for the yes forecast between equation 47 (54.7 percent correct), RH4 (54.5 percent correct) and equation 36 (54.0 percent correct). For the no forecast, equation 47 is better than RH4 for all time periods. The equation 47 E.E. is slightly worse than the RH4 value but the detailed performance summary in Table 28 suggests that the overall use of equation 47 would produce optimum results. The biggest motivation for forecasting the afternoon RAOB is the improvement in the ability to make a low probability

make a correct yes forecast 32.7 percent of the time (RH4 > 49.9) and a correct no forecast 92.7 percent of the time when RH4 is less than 50.0.

o. The Use of JJA Single Predictors to Forecast Thunder. The JJA 12Z RAOB data period TSTM frequency of occurence is 19.0 percent. The single predictors attain their maximum relative performance for this period (see Tables 24 and 27). The percent reduction of variance for RH4 is 23.7 compared to 27.6 for best JJA 12Z equation 46. The RH4 figure is 4.1 percent less than the equation 46 value. This compares to a drop of 7.2 percent for the best 12Z MJS predictor (K) when compared to the best MJS 12Z equation 37 value. For the JJA 12Z period, the 1970-83 RH4 percent correct of 81.8 is better than the best 12Z JJA equation, however the RH4 skill score is smaller (0.39 compared to 0.45 for equation 46). The RH4 E.E. (0.174) is also better as is the E.E. (0.111) for the second best predictor PW. More detailed analysis using Table 27 assists the comparative evaluation. For low probability forecasts equation 46 is best

Table 27. Percent of Time JJA 12Z TSTM Predictors or Equations Are Correct.

Eqn or Indepen-dent Var	Percent of Probabilities <5 % for Indicated Yrs 1970-78	1979-83	1970-83	Lower Limit	Percent of Correct Yes Fcsts for Indicated Yrs 1970-78	1979-83	1970-83	Upper Limit	Percent of Correct No Fcsts for Indicated Yrs 1970-78	1979-83	1970-83
41(R<0.1)	14.0	16.0	14.7	(>0.59)	54.3	41.1	48.3	(<0.60)	89.7	88.5	89.3
46(R<0.07)	32.3	27.7	30.3	(>0.34)	56.9	43.7	51.4	(<0.35)	91.7	89.0	90.8
RH4(<25.0)	17.7	14.6	16.6	(>54.9)	55.4	47.2	52.2	(<55.0)	88.7	86.5	88.0
PW(<0.4)	11.4	17.9	15.6	(>0.79)	52.0	46.5	49.8	(<0.80)	88.8	87.9	88.5
K(<10.0)	14.5	16.2	15.1	(>27.4)	50.4	42.7	47.1	(<27.5)	88.8	87.9	88.5
TOT(<20.0)	13.7	14.1	13.8	(>28.9)	35.9	34.6	35.4	(<29.0)	88.3	88.3	88.3
LI[a](>14.9)	0.3	4.8	1.9	(<2.0)	44.9	39.4	43.2	(>1.9)	88.7	84.2	87.1

[a]Abbreviation for LINWS.

on the independent data (27.7 percent), dependent data (32.3 percent) and overall (30.3 percent). RH4 less than 25 is the best 1970-83 low-probability predictor (less than five percent 16.6 percent of the time). PW and K are second and third (15.6 and 15.1 percent). LINWS and TOT were relatively less useful than was true in the MJS 12Z period. For the ability to forecast yes correctly, an RH4 value greater than 54.9 is best on the 12Z JJA independent data (47.2 percent correct). A PW value of more than 0.79 is second best (46.5 percent correct). An equation 46 answer of more than 0.34 is third (43.7 percent correct). For the 1970-83 correct yes forecasts, RH4 is again best with value of 52.2 percent. Equation 46 is second (51.4 percent correct). PW is third with 49.8 percent correct. In the ability to forecast no correctly, the two equations are better than any of the predictors. Equation 46 is best for the dependent data, independent data and overall (90.8 percent). In summary, because of the high 1970-83 S.S. and percent correct, Equation 46 results would produce the best yes or no forecasts. If R(46) is less than 0.07 (true 30.3 percent of the time), a less than five percent probability forecast can be made. If the best low probability predictor (RH4 less than 25.0) is

probabilities less than five percent. It is also correct 47.2 percent of the time for a yes forecast if R(44) is greater than 0.34. The probability of being correct for a no forecast using equation 44 is 90.6 percent. This is third best in Table 25. The best score for this is obtained by TOT (92.1 percent correct). In spite of this R(44) is superior overall. The equation 44 skill scores and percent correct are better than any other MJS 12Z predictor or equation. The E.E. is only slightly larger than the value for K. The predictors can be used alone but their use cannot be superimposed on equation results. For instance, if the best predictor in Table 25, LINWS is used only when R(44) is not less than 0.12 but LINWS is greater than 7.9, the 1970-83 percent of occurence is 6.3 (not the required value of less than five). Used alone, however, LINWS values greater than 7.9 produce probabilities of less than five percent 34.5 percent of the time. For an LINWS value of less than three, a yes forecast is correct 35.8 percent of the time. For LINWS equal to three or more, a no forecast is correct 89.7 percent of the time. Inspection of Table 24 shows that the 1970-83 S.S. for LINWS is 0.29. The percent correct is 77.4 and the E.E. is 0.322. These values are all less good than the ones for K or the values for either of the MJS 12Z equations. Single predictors should be used alone. Single predictor results cannot be correctly superimposed on equation results. Similar values for four other predictors appear in Table 25.

The summary of MJS 00Z TSTM forecast results appears in Tables 24 and 26. For this sample, TSTM occurs 13.7 percent of the time for the 1200 to 2400 MST

Table 26. Percent of Time MJS 00Z TSTM Predictors or Equations Are Correct.

Eqn or Indepen-dent Var	Percent of Probabilities <5 % for Indicated Yrs 1970-78	1979-83	1970-83	Lower Limit	Percent of Correct Yes Fcsts for Indicated Yrs 1970-78	1979-83	1970-83	Upper Limit	Percent of Correct No Fcsts for Indicated Yrs 1970-78	1979-83	1970-83
21(R<0.3)	46.0	36.3	42.7	(>0.59)	34.7	41.9	37.7	(<0.60)	90.0	93.9	91.3
45(R<0.1)	47.9	33.4	42.9	(>0.34)	55.3	37.1	46.6	(<0.35)	91.6	92.2	91.8
RH4(<30.0)	38.6	25.8	34.1	(>49.9)	35.8	28.4	32.7	(<50.0)	92.6	93.0	92.7
PW(<0.25)	9.9	3.6	7.7	(>0.54)	38.4	26.1	32.6	(<0.55)	93.5	94.1	93.6
K(<15.0)	31.6	17.2	26.6	(>24.9)	38.7	24.5	31.8	(<25.0)	93.8	94.2	93.9
TOT(<22.5)	32.3	24.0	29.4	(>27.9)	27.3	24.4	26.1	(<28.0)	94.3	95.7	94.7
LI[a](>3.9)	30.7	19.6	26.8	(<0.5)	27.2	24.1	25.7	(>0.49)	90.1	92.6	90.8

[a]Abbreviation for LINWS.

period. The MJS 00Z predictor percent correct figures are smaller than the 12Z values (see Table 24). The best 00Z predictor, RH4 has a slightly lower 1970-83 S.S. (0.30) than the best 12Z predictor (TOT) value of 0.33. The 00Z E.E. are larger, but it is interesting that the E.E. for RH4 is 0.350, compared to the best 00Z equation value of 0.386 (equation 21). If one is limited to using only one predictor, it appears from Tables 24 and 26 that the best choice would be RH4. This predictor can be used to forecast probability of occurence of less than five percent 34.1 percent of the time (when RH4 < 30.0),

Table A.6. Equation 31 Frequency Table for MJS 1979-81.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.071	0	8	0.000	3.7		
0.0 - 0.1	0.049	0	9	0.000	4.2	0.000	7.9
0.1 - 0.2	0.150	2	22	0.091	10.3		
0.2 - 0.3	0.243	5	18	0.278	8.4	0.175	18.7
0.3 - 0.4	0.344	3	22	0.136	10.3		
0.4 - 0.5	0.456	7	29	0.241	13.6	0.196	23.8
0.5 - 0.6	0.556	9	16	0.563	7.5		
0.6 - 0.7	0.653	8	14	0.571	6.5	0.567	14.0
0.7 - 0.8	0.753	13	17	0.765	7.9		
0.8 - 0.9	0.850	17	22	0.773	10.3	0.769	18.2
0.9 - 1.0	0.947	17	17	1.000	7.9		
1.0 - 3.0	1.095	20	20	1.000	9.3	1.000	17.3
(-1.0) - 3.0	0.542	101	214	0.472		0.472	

Table A.7. Equations 30 and 31 12Z Radiosonde Cumulonimbus or Precipitation Contingency Tables for May 1 to June 14 and September.

CONTINGENCY TABLE

MONTH: MJS YEARS: 1982-83 LOCATION: KSLC

EQUATION: 30 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	69	12	81
C S	NO	19	47	66
T	TOTAL	88	59	147

E: 75.0 SS: 0.570 CORRECT: 78.9 %

EQUATION: 31 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	73	14	87
C S	NO	15	45	60
T	TOTAL	88	59	147

E: 76.2 SS: 0.591 CORRECT: 80.3 %

Table A.8. Equation 30 Frequency Table for MJS 1982-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.184	2	13	0.154	8.8		
0.0 - 0.1	0.062	2	7	0.286	4.8	0.200	13.6
0.1 - 0.2	0.133	2	14	0.143	9.5		
0.2 - 0.3	0.241	2	6	0.333	4.1	0.200	13.6
0.3 - 0.4	0.333	3	13	0.231	8.8		
0.4 - 0.5	0.451	8	13	0.615	8.8	0.423	17.7
0.5 - 0.6	0.552	8	13	0.615	8.8		
0.6 - 0.7	0.656	12	17	0.706	11.6	0.667	20.4
0.7 - 0.8	0.746	15	16	0.938	10.9		
0.8 - 0.9	0.836	10	11	0.909	7.5	0.926	18.4
0.9 - 1.0	0.961	13	13	1.000	8.8		
1.0 - 3.0	1.063	11	11	1.000	7.5	1.000	16.3
(-1.0) - 3.0	0.511	88	147	0.599		0.599	

Table A.9. Equation 31 Frequency Table for MJS 1982-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.226	1	11	0.091	7.5		
0.0 - 0.1	0.039	2	6	0.333	4.1	0.176	11.6
0.1 - 0.2	0.155	1	12	0.083	8.2		
0.2 - 0.3	0.242	3	10	0.300	6.8	0.182	15.0
0.3 - 0.4	0.346	2	10	0.200	6.8		
0.4 - 0.5	0.438	6	11	0.545	7.5	0.381	14.3
0.5 - 0.6	0.553	8	13	0.615	8.8		
0.6 - 0.7	0.657	13	18	0.722	12.2	0.677	21.1
0.7 - 0.8	0.749	13	16	0.813	10.9		
0.8 - 0.9	0.845	13	14	0.929	9.5	0.867	20.4
0.9 - 1.0	0.944	10	10	1.000	6.8		
1.0 - 3.0	1.051	16	16	1.000	10.9	1.000	17.7
(-1.0) - 3.0	0.540	88	147	0.599		0.599	

Table A.10. Equations 30 and 31 12Z Radiosonde Cumulonimbus or Precipitation Contingency Tables for May 1 to June 14 and September.

CONTINGENCY TABLE

MONTH: MJS YEARS: 1979-83 LOCATION: KSLC

EQUATION: 30 TIME: 12Z

		OBSERVED YES	NO	TOTAL
F	YES	151	31	182
C S	NO	38	141	179
T	TOTAL	189	172	361

E: 180.6 SS: 0.618 CORRECT: 80.9 %

EQUATION: 31 TIME: 12Z

		OBSERVED YES	NO	TOTAL
F	YES	157	36	193
C S	NO	32	136	168
T	TOTAL	189	172	361

E: 181.1 SS: 0.622 CORRECT: 81.2 %

Table A.11. Equation 30 Frequency Table for MJS 1979-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.137	2	22	0.091	6.1		
0.0 - 0.1	0.054	3	19	0.158	5.3	0.122	11.4
0.1 - 0.2	0.142	4	38	0.105	10.5		
0.2 - 0.3	0.249	7	29	0.241	8.0	0.164	18.6
0.3 - 0.4	0.342	8	34	0.235	9.4		
0.4 - 0.5	0.450	14	37	0.378	10.2	0.310	19.7
0.5 - 0.6	0.547	17	26	0.654	7.2		
0.6 - 0.7	0.651	20	32	0.625	8.9	0.638	16.1
0.7 - 0.8	0.740	28	34	0.824	9.4		
0.8 - 0.9	0.842	28	32	0.875	8.9	0.848	18.3
0.9 - 1.0	0.953	29	29	1.000	8.0		
1.0 - 3.0	1.082	29	29	1.000	8.0	1.000	16.1
(-1.0) - 3.0	0.513	189	361	0.524		0.524	

Table A.12. Equation 31 Frequency Table for MJS 1979-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS		TWO TENTHS R CLASS	
				FREQ	PRCNT	FREQ	PRCNT
(-1.0)-(-0.0)	-0.161	1	19	0.053	5.3		
0.0 - 0.1	0.045	2	15	0.133	4.2	0.088	9.4
0.1 - 0.2	0.152	3	34	0.088	9.4		
0.2 - 0.3	0.243	8	28	0.286	7.8	0.177	17.2
0.3 - 0.4	0.344	5	32	0.156	8.9		
0.4 - 0.5	0.451	13	40	0.325	11.1	0.250	19.9
0.5 - 0.6	0.554	17	29	0.586	8.0		
0.6 - 0.7	0.655	21	32	0.656	8.9	0.623	16.9
0.7 - 0.8	0.751	26	33	0.788	9.1		
0.8 - 0.9	0.848	30	36	0.833	10.0	0.812	19.1
0.9 - 1.0	0.946	27	27	1.000	7.5		
1.0 - 3.0	1.076	36	36	1.000	10.0	1.000	17.5
(-1.0) - 3.0	0.541	189	361	0.524		0.524	

Table A.13. Equations 30 and 31 12Z Radiosonde Cumulonimbus or Precipitation Contingency Tables for May 1 to June 14 and September.

CONTINGENCY TABLE

MONTH: MJS YEARS: 1970-83 LOCATION: KSLC

EQUATION: 30 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	380	83	463
C				
	NO	106	443	549
S				
T	TOTAL	486	526	1012

E: 507.7 SS: 0.625 CORRECT: 81.3 %

EQUATION: 31 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	397	100	497
C				
	NO	89	426	515
S				
T	TOTAL	486	526	1012

E: 506.4 SS: 0.626 CORRECT: 81.3 %

Table A.14. Equation 30 Frequency Table for MJS 1970-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.115	4	78	0.051	7.7		
0.0 - 0.1	0.057	3	68	0.044	6.7	0.048	14.4
0.1 - 0.2	0.145	11	98	0.112	9.7		
0.2 - 0.3	0.250	19	86	0.221	8.5	0.163	18.2
0.3 - 0.4	0.348	31	118	0.263	11.7		
0.4 - 0.5	0.450	38	101	0.376	10.0	0.315	21.6
0.5 - 0.6	0.546	50	83	0.602	8.2		
0.6 - 0.7	0.649	65	97	0.670	9.6	0.639	17.8
0.7 - 0.8	0.746	69	79	0.873	7.8		
0.8 - 0.9	0.847	72	78	0.923	7.7	0.898	15.5
0.9 - 1.0	0.949	61	63	0.968	6.2		
1.0 - 3.0	1.091	63	63	1.000	6.2	0.984	12.5
(-1.0) - 3.0	0.473	486	1012	0.480		0.480	

Table A.15. Equation 31 Frequency Table for MJS 1970-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.132	3	69	0.043	6.8		
0.0 - 0.1	0.054	2	55	0.036	5.4	0.040	12.3
0.1 - 0.2	0.150	6	94	0.064	9.3		
0.2 - 0.3	0.243	20	77	0.260	7.6	0.152	16.9
0.3 - 0.4	0.351	24	113	0.212	11.2		
0.4 - 0.5	0.449	34	107	0.318	10.6	0.264	21.7
0.5 - 0.6	0.551	53	96	0.552	9.5		
0.6 - 0.7	0.650	56	86	0.651	8.5	0.599	18.0
0.7 - 0.8	0.744	76	93	0.817	9.2		
0.8 - 0.9	0.851	68	76	0.895	7.5	0.852	16.7
0.9 - 1.0	0.940	74	76	0.974	7.5		
1.0 - 3.0	1.089	70	70	1.000	6.9	0.986	14.4
(-1.0) - 3.0	0.499	486	1012	0.480		0.480	

Table A.16. Equations 34 and 11 00Z Radiosonde Cumulonimbus or Precipitation Contingency Tables for May 1 to June 14 and September.

CONTINGENCY TABLE

MONTH: MJS YEARS: 1970-78 LOCATION: KSLC

EQUATION: 34 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	250	46	296
C S	NO	42	334	376
T	TOTAL	292	380	672

E: 341.2 SS: 0.734 CORRECT: 86.9 %

EQUATION: 11 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	219	26	245
C S	NO	73	354	427
T	TOTAL	292	380	672

E: 347.9 SS: 0.695 CORRECT: 85.3 %

Table A.17. Equation 34 Frequency Table for MJS 1970-78.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.125	0	69	0.000	10.3		
0.0 - 0.1	0.052	0	56	0.000	8.3	0.000	18.6
0.1 - 0.2	0.155	3	60	0.050	8.9		
0.2 - 0.3	0.248	5	65	0.077	9.7	0.064	18.6
0.3 - 0.4	0.346	15	71	0.211	10.6		
0.4 - 0.5	0.448	19	55	0.345	8.2	0.270	18.8
0.5 - 0.6	0.554	31	53	0.585	7.9		
0.6 - 0.7	0.648	40	51	0.784	7.6	0.683	15.5
0.7 - 0.8	0.742	51	59	0.864	8.8		
0.8 - 0.9	0.840	31	33	0.939	4.9	0.891	13.7
0.9 - 1.0	0.945	36	37	0.973	5.5		
1.0 - 3.0	1.115	61	63	0.968	9.4	0.970	14.9
(-1.0) - 3.0	0.458	292	672	0.435		0.435	

Table A.18. Equation 11 Frequency Table for MJS 1970-78.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.106	0	76	0.000	11.3		
0.0 - 0.1	0.058	1	56	0.018	8.3	0.008	19.6
0.1 - 0.2	0.154	3	78	0.038	11.6		
0.2 - 0.3	0.252	13	71	0.183	10.6	0.107	22.2
0.3 - 0.4	0.351	21	83	0.253	12.4		
0.4 - 0.5	0.453	35	63	0.556	9.4	0.384	21.7
0.5 - 0.6	0.543	40	55	0.727	8.2		
0.6 - 0.7	0.650	40	46	0.870	6.8	0.792	15.0
0.7 - 0.8	0.745	45	47	0.957	7.0		
0.8 - 0.9	0.842	37	39	0.949	5.8	0.953	12.8
0.9 - 1.0	0.939	31	31	1.000	4.6		
1.0 - 3.0	1.092	26	27	0.963	4.0	0.983	8.6
(-1.0) - 3.0	0.400	292	672	0.435		0.435	

Table A.19. Equations 34 and 11 00Z Radiosonde Cumulonimbus or Precipitation Contingency Tables for May 1 to June 14 and September.

CONTINGENCY TABLE

MONTH: MJS YEARS: 1979–81 LOCATION: KSLC

EQUATION: 34 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	82	23	105
C S	NO	8	101	109
T	TOTAL	90	124	214

E: 107.3 SS: 0.709 CORRECT: 85.5 %

EQUATION: 11 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	80	19	99
C S	NO	10	105	115
T	TOTAL	90	124	214

E: 108.3 SS: 0.726 CORRECT: 86.4 %

Table A.33. Equation 16 Frequency Table for JJA 1970-78.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.071	0	14	0.000	2.0		
0.0 - 0.1	0.059	0	28	0.000	4.1	0.000	6.1
0.1 - 0.2	0.154	3	53	0.057	7.7		
0.2 - 0.3	0.250	8	97	0.082	14.1	0.073	21.8
0.3 - 0.4	0.352	25	93	0.269	13.5		
0.4 - 0.5	0.448	32	95	0.337	13.8	0.303	27.3
0.5 - 0.6	0.548	37	77	0.481	11.2		
0.6 - 0.7	0.646	44	70	0.629	10.2	0.551	21.4
0.7 - 0.8	0.751	57	62	0.919	9.0		
0.8 - 0.9	0.843	37	46	0.804	6.7	0.870	15.7
0.9 - 1.0	0.949	26	28	0.929	4.1		
1.0 - 3.0	1.146	25	25	1.000	3.6	0.962	7.7
(-1.0) - 3.0	0.489	294	688	0.427		0.427	

Table A.32. Equation 27 Frequency Table for JJA 1970-78.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.095	0	37	0.000	5.4	0.037	11.9
0.0 - 0.1	0.061	3	45	0.067	6.5		
0.1 - 0.2	0.150	4	77	0.052	11.2	0.097	22.4
0.2 - 0.3	0.248	11	77	0.143	11.2		
0.3 - 0.4	0.351	19	74	0.257	10.8	0.261	19.5
0.4 - 0.5	0.451	16	60	0.267	8.7		
0.5 - 0.6	0.544	32	65	0.492	9.4	0.549	19.3
0.6 - 0.7	0.647	41	68	0.603	9.9		
0.7 - 0.8	0.740	50	56	0.893	8.1	0.894	13.7
0.8 - 0.9	0.844	34	38	0.895	5.5		
0.9 - 1.0	0.954	24	31	0.774	4.5	0.923	13.2
1.0 - 3.0	1.138	60	60	1.000	8.7		
(-1.0) - 3.0	0.485	294	688	0.427		0.427	

Table A.31. Equations 27 and 16 12Z Radiosonde Cumulonimbus or Precipitation Contingency Tables for June 15 to August 31.

CONTINGENCY TABLE

MONTH: JJA YEARS: 1970-78 LOCATION: KSLC

EQUATION: 27 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	241	77	318
C				
	NO	53	317	370
S				
T	TOTAL	294	394	688

E: 347.8 SS: 0.618 CORRECT: 81.1 %

EQUATION: 16 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	226	82	308
C				
	NO	68	312	380
S				
T	TOTAL	294	394	688

E: 349.2 SS: 0.557 CORRECT: 78.2 %

Table A.30. Equation 11 Frequency Table for MJS 1970-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.105	0	102	0.000	9.9		
0.0 - 0.1	0.058	1	74	0.014	7.2	0.006	17.1
0.1 - 0.2	0.153	3	103	0.029	10.0		
0.2 - 0.3	0.250	15	115	0.130	11.2	0.083	21.2
0.3 - 0.4	0.353	26	118	0.220	11.5		
0.4 - 0.5	0.453	45	93	0.484	9.0	0.336	20.5
0.5 - 0.6	0.544	56	84	0.667	8.2		
0.6 - 0.7	0.648	67	82	0.817	8.0	0.741	16.1
0.7 - 0.8	0.748	74	81	0.914	7.9		
0.8 - 0.9	0.848	65	68	0.956	6.6	0.933	14.5
0.9 - 1.0	0.945	52	54	0.963	5.2		
1.0 - 3.0	1.086	54	56	0.964	5.4	0.964	10.7
(-1.0) - 3.0	0.438	458	1030	0.445		0.445	

Table A.29. Equation 34 Frequency Table for MJS 1970-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.125	0	93	0.000	9.0		
0.0 - 0.1	0.053	0	69	0.000	6.7	0.000	15.7
0.1 - 0.2	0.156	3	81	0.037	7.9		
0.2 - 0.3	0.253	5	102	0.049	9.9	0.044	17.8
0.3 - 0.4	0.347	21	106	0.198	10.3		
0.4 - 0.5	0.446	27	85	0.318	8.3	0.251	18.5
0.5 - 0.6	0.552	41	75	0.547	7.3		
0.6 - 0.7	0.650	61	88	0.693	8.5	0.626	15.8
0.7 - 0.8	0.744	72	86	0.837	8.3		
0.8 - 0.9	0.843	58	69	0.841	6.7	0.839	15.0
0.9 - 1.0	0.951	60	63	0.952	6.1		
1.0 - 3.0	1.117	110	113	0.973	11.0	0.966	17.1
(-1.0) - 3.0	0.497	458	1030	0.445		0.445	

Table A.28. Equations 34 and 11 00Z Radiosonde Cumulonimbus or Precipitation Contingency Tables for May 1 to June 14 and September.

CONTINGENCY TABLE

MONTH: MJS YEARS: 1970-83 LOCATION: KSLC

EQUATION: 34 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	402	92	494
C				
	NO	56	480	536
S				
T	TOTAL	458	572	1030

E: 517.3 SS: 0.711 CORRECT: 85.6 %

EQUATION: 11 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	368	57	425
C				
	NO	90	515	605
S				
T	TOTAL	458	572	1030

E: 525.0 SS: 0.709 CORRECT: 85.7 %

Table A.27. Equation 11 Frequency Table for MJS 1979-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.103	0	26	0.000	7.3		
0.0 - 0.1	0.066	0	18	0.000	5.0	0.000	12.3
0.1 - 0.2	0.150	0	25	0.000	7.0		
0.2 - 0.3	0.247	2	44	0.045	12.3	0.029	19.3
0.3 - 0.4	0.356	5	35	0.143	9.8		
0.4 - 0.5	0.454	10	30	0.333	8.4	0.231	18.2
0.5 - 0.6	0.547	16	29	0.552	8.1		
0.6 - 0.7	0.645	27	36	0.750	10.1	0.662	18.2
0.7 - 0.8	0.751	29	34	0.853	9.5		
0.8 - 0.9	0.857	28	29	0.966	8.1	0.905	17.6
0.9 - 1.0	0.952	21	23	0.913	6.4		
1.0 - 3.0	1.080	28	29	0.966	8.1	0.942	14.5
(-1.0) - 3.0	0.508	166	358	0.464		0.464	

Table A.26. Equation 34 Frequency Table for MJS 1979-83.

				ONE TENTH R CLASS		TWO TENTHS R CLASS	
ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	FREQ	PRCNT	FREQ	PRCNT
(-1.0)-(-0.0)	-0.127	0	24	0.000	6.7		
0.0 - 0.1	0.056	0	13	0.000	3.6	0.000	10.3
0.1 - 0.2	0.157	0	21	0.000	5.9		
0.2 - 0.3	0.261	0	37	0.000	10.3	0.000	16.2
0.3 - 0.4	0.350	6	35	0.171	9.8		
0.4 - 0.5	0.442	8	30	0.267	8.4	0.215	18.2
0.5 - 0.6	0,547	10	22	0.455	6.1		
0.6 - 0.7	0.652	21	37	0.568	10.3	0.525	16.5
0.7 - 0.8	0.749	21	27	0.778	7.5		
0.8 - 0.9	0.845	27	36	0.750	10.1	0.762	17.6
0.9 - 1.0	0.959	24	26	0.923	7.3		
1.0 - 3.0	1.119	49	50	0.980	14.0	0.961	21.2
(-1.0) - 3.0	0.569	166	358	0.464		0.464	

Table A.25. Equations 34 and 11 00Z Radiosonde Cumulonimbus or Precipitation Contingency Tables for May 1 to June 14 and September.

CONTINGENCY TABLE

MONTH: MJS YEARS: 1979-83 LOCATION: KSLC

EQUATION: 34 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
FCST	YES	152	46	198
	NO	14	146	160
	TOTAL	166	192	358

E: 177.6 SS: 0.667 CORRECT: 83.2 %

EQUATION: 11 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
FCST	YES	149	31	180
	NO	17	161	178
	TOTAL	166	192	358

E: 178.9 SS: 0.732 CORRECT: 86.6 %

Table A.24. Equation 11 Frequency Table for MJS 1982-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.121	0	12	0.000	8.3		
0.0 - 0.1	0.072	0	6	0.000	4.2	0.000	12.5
0.1 - 0.2	0.153	0	8	0.000	5.6		
0.2 - 0.3	0.241	1	10	0.100	6.9	0.056	12.5
0.3 - 0.4	0.352	3	16	0.188	11.1		
0.4 - 0.5	0.464	3	11	0.273	7.6	0.222	18.8
0.5 - 0.6	0.545	8	15	0.533	10.4		
0.6 - 0.7	0.643	12	14	0.857	9.7	0.690	20.1
0.7 - 0.8	0.753	15	18	0.833	12.5		
0.8 - 0.9	0.853	14	14	1.000	9.7	0.906	22.2
0.9 - 1.0	0.948	11	11	1.000	7.6		
1.0 - 3.0	1.084	9	9	1.000	6.3	1.000	13.9
(-1.0) - 3.0	0.529	76	144	0.528		0.528	

Table A.23. Equation 34 Frequency Table for MJS 1982-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.150	0	8	0.000	5.6		
0.0 - 0.1	0.040	0	5	0.000	3.5	0.000	9.0
0.1 - 0.2	0.171	0	4	0.000	2.8		
0.2 - 0.3	0.264	0	14	0.000	9.7	0.000	12.5
0.3 - 0.4	0.344	3	12	0.250	8.3		
0.4 - 0.5	0.434	3	8	0.375	5.6	0.300	13.9
0.5 - 0.6	0.550	6	13	0.462	9.0		
0.6 - 0.7	0.656	10	20	0.500	13.9	0.485	22.9
0.7 - 0.8	0.739	9	12	0.750	8.3		
0.8 - 0.9	0.833	12	15	0.800	10.4	0.778	18.8
0.9 - 1.0	0.950	9	9	1.000	6.3		
1.0 - 3.0	1.110	24	24	1.000	16.7	1.000	22.9
(-1.0) - 3.0	0.610	76	144	0.528		0.528	

Table A.22. Equations 34 and 11 00Z Radiosonde Cumulonimbus or Precipitation Contingency Tables for May 1 to June 14 and September.

CONTINGENCY TABLE

MONTH: MJS YEARS: 1982-83 LOCATION: KSLC

EQUATION: 34 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	70	23	93
C S	NO	6	45	51
T	TOTAL	76	68	144

E: 73.2 SS: 0.591 CORRECT: 79.9 %

EQUATION: 11 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	69	12	81
C S	NO	7	56	63
T	TOTAL	76	68	144

E: 72.5 SS: 0.734 CORRECT: 86.8 %

Table A.21. Equation 11 Frequency Table for MJS 1979-81.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.087	0	14	0.000	6.5		
0.0 - 0.1	0.048	0	12	0.000	5.6	0.000	12.1
0.1 - 0.2	0.149	0	17	0.000	7.9		
0.2 - 0.3	0.249	1	34	0.029	15.9	0.020	23.8
0.3 - 0.4	0.360	2	19	0.105	8.9		
0.4 - 0.5	0.449	7	19	0.368	8.9	0.237	17.8
0.5 - 0.6	0.549	8	14	0.571	6.5		
0.6 - 0.7	0.646	15	22	0.682	10.3	0.639	16.8
0.7 - 0.8	0.750	14	16	0.875	7.5		
0.8 - 0.9	0.861	14	15	0.933	7.0	0.903	14.5
0.9 - 1.0	0.955	10	12	0.833	5.6		
1.0 - 3.0	1.078	19	20	0.950	9.3	0.906	15.0
(-1.0) - 3.0	0.493	90	214	0.421		0.421	

Table A.20. Equation 34 Frequency Table for MJS 1979-81.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.115	0	16	0.000	7.5		
0.0 - 0.1	0.065	0	8	0.000	3.7	0.000	11.2
0.1 - 0.2	0.154	0	17	0.000	7.9		
0.2 - 0.3	0.259	0	23	0.000	10.7	0.000	18.7
0.3 - 0.4	0.354	3	23	0.130	10.7		
0.4 - 0.5	0.445	5	22	0.227	10.3	0.178	21.0
0.5 - 0.6	0.543	4	9	0.444	4.2		
0.6 - 0.7	0.647	11	17	0.647	7.9	0.577	12.1
0.7 - 0.8	0.757	12	15	0.800	7.0		
0.8 - 0.9	0.854	15	21	0.714	9.8	0.750	16.8
0.9 - 1.0	0.964	15	17	0.882	7.9		
1.0 - 3.0	1.128	25	26	0.962	12.1	0.930	20.1
(-1.0) - 3.0	0.542	90	214	0.421		0.421	

Table A.34. Equations 27 and 16 12Z Radiosonde Cumulonimbus or Precipitation Contingency Tables for June 15 to August 31.

CONTINGENCY TABLE

MONTH: JJA   YEARS: 1979-81   LOCATION: KSLC

EQUATION: 27   TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	69	20	89
C S	NO	33	105	138
T	TOTAL	102	125	227

E: 116.0   SS: 0.523   CORRECT: 76.7 %

EQUATION: 16   TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	67	24	91
C S	NO	35	101	136
T	TOTAL	102	125	227

E: 115.8   SS: 0.470   CORRECT: 74.0 %

Table A.35. Equation 27 Frequency Table for JJA 1979-81.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.066	1	14	0.071	6.2		
0.0 - 0.1	0.060	1	21	0.048	9.3	0.057	15.4
0.1 - 0.2	0.150	0	23	0.000	10.1		
0.2 - 0.3	0.250	8	28	0.286	12.3	0.157	22.5
0.3 - 0.4	0.338	12	30	0.400	13.2		
0.4 - 0.5	0.463	11	22	0.500	9.7	0.442	22.9
0.5 - 0.6	0.561	10	18	0.556	7.9		
0.6 - 0.7	0.647	19	24	0.792	10.6	0.690	18.5
0.7 - 0.8	0.749	8	11	0.727	4.8		
0.8 - 0.9	0.847	15	17	0.882	7.5	0.821	12.3
0.9 - 1.0	0.926	6	8	0.750	3.5		
1.0 - 3.0	1.104	11	11	1.000	4.8	0.895	8.4
(-1.0) - 3.0	0.436	102	227	0.449		0.449	

Table A.36. Equation 16 Frequency Table for JJA 1979-81.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.076	0	4	0.000	1.8		
0.0 - 0.1	0.054	1	16	0.063	7.0	0.050	8.8
0.1 - 0.2	0.161	2	29	0.069	12.8		
0.2 - 0.3	0.249	5	30	0.167	13.2	0.119	26.0
0.3 - 0.4	0.352	11	30	0.367	13.2		
0.4 - 0.5	0.455	16	27	0.593	11.9	0.474	25.1
0.5 - 0.6	0.549	16	26	0.615	11.5		
0.6 - 0.7	0.638	14	23	0.609	10.1	0.612	21.6
0.7 - 0.8	0.743	15	19	0.789	8.4		
0.8 - 0.9	0.845	8	9	0.889	4.0	0.821	12.3
0.9 - 1.0	0.954	4	4	1.000	1.8		
1.0 - 3.0	1.089	10	10	1.000	4.4	1.000	6.2
(-1.0) - 3.0	0.445	102	227	0.449		0.449	

Table A.37. Equations 27 and 16 12Z Radiosonde Cumulonimbus or Precipitation Contingency Tables for June 15 to August 31.

CONTINGENCY TABLE

MONTH: JJA   YEARS: 1982-83   LOCATION: KSLC

EQUATION: 27   TIME: 12Z

OBSERVED

		YES	NO	TOTAL
F	YES	68	30	98
C S	NO	13	38	51
T	TOTAL	81	68	149

E: 76.6   SS: 0.406   CORRECT: 71.1 %

EQUATION: 16   TIME: 12Z

OBSERVED

		YES	NO	TOTAL
F	YES	70	28	98
C S	NO	11	40	51
T	TOTAL	81	68	149

E: 76.6   SS: 0.462   CORRECT: 73.8 %

Table A.38. Equation 27 Frequency Table for JJA 1982-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.153	1	8	0.125	5.4		
0.0 - 0.1	0.080	1	6	0.167	4.0	0.143	9.4
0.1 - 0.2	0.157	2	7	0.286	4.7		
0.2 - 0.3	0.249	1	7	0.143	4.7	0.214	9.4
0.3 - 0.4	0.353	4	15	0.267	10.1		
0.4 - 0.5	0.444	4	8	0.500	5.4	0.348	15.4
0.5 - 0.6	0.548	7	18	0.389	12.1		
0.6 - 0.7	0.657	8	14	0.571	9.4	0.469	21.5
0.7 - 0.8	0.743	11	15	0.733	10.1		
0.8 - 0.9	0.843	10	15	0.667	10.1	0.700	20.1
0.9 - 1.0	0.940	10	12	0.833	8.1		
1.0 - 3.0	1.136	22	24	0.917	16.1	0.889	24.2
(-1.0) - 3.0	0.620	81	149	0.544		0.544	

Table A.39. Equation 16 Frequency Table for JJA 1982-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.054	0	4	0.000	2.7		
0.0 - 0.1	0.063	1	5	0.200	3.4	0.111	6.0
0.1 - 0.2	0.125	0	3	0.000	2.0		
0.2 - 0.3	0.248	1	10	0.100	6.7	0.077	8.7
0.3 - 0.4	0.351	3	19	0.158	12.8		
0.4 - 0.5	0.460	6	10	0.600	6.7	0.310	19.5
0.5 - 0.6	0.545	8	21	0.381	14.1		
0.6 - 0.7	0.646	10	16	0.625	10.7	0.486	24.8
0.7 - 0.8	0.751	19	25	0.760	16.8		
0.8 - 0.9	0.853	10	12	0.833	8.1	0.784	24.8
0.9 - 1.0	0.941	10	10	1.000	6.7		
1.0 - 3.0	1.106	13	14	0.929	9.4	0.958	16.1
(-1.0) - 3.0	0.603	81	149	0.544		0.544	

Table A.40. Equations 27 and 16 12Z Radiosonde Cumulonimbus or Precipitation Contingency Tables for June 15 to August 31.

CONTINGENCY TABLE

MONTH: JJA YEARS: 1979-83 LOCATION: KSLC

EQUATION: 27 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	137	50	187
C S	NO	46	143	189
T	TOTAL	183	193	376

E: 188.0 SS: 0.489 CORRECT: 74.5 %

EQUATION: 16 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	137	52	189
C S	NO	46	141	187
T	TOTAL	183	193	376

E: 188.0 SS: 0.479 CORRECT: 73.9 %

Table A.41. Equation 27 Frequency Table for JJA 1979-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.098	2	22	0.091	5.9		
0.0 - 0.1	0.065	2	27	0.074	7.2	0.082	13.0
0.1 - 0.2	0.151	2	30	0.067	8.0		
0.2 - 0.3	0.249	9	35	0.257	9.3	0.169	17.3
0.3 - 0.4	0.343	16	45	0.356	12.0		
0.4 - 0.5	0.458	15	30	0.500	8.0	0.413	19.9
0.5 - 0.6	0.554	17	36	0.472	9.6		
0.6 - 0.7	0.650	27	38	0.711	10.1	0.595	19.7
0.7 - 0.8	0.745	19	26	0.731	6.9		
0.8 - 0.9	0.845	25	32	0.781	8.5	0.759	15.4
0.9 - 1.0	0.934	16	20	0.800	5.3		
1.0 - 3.0	1.126	33	35	0.943	9.3	0.891	14.6
(-1.0) - 3.0	0.509	183	376	0.487		0.487	

Table A.42. Equation 16 Frequency Table for JJA 1979-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.065	0	8	0.000	2.1		
0.0 - 0.1	0.056	2	21	0.095	5.6	0.069	7.7
0.1 - 0.2	0.158	2	32	0.063	8.5		
0.2 - 0.3	0.249	6	40	0.150	10.6	0.111	19.1
0.3 - 0.4	0.352	14	49	0.286	13.0		
0.4 - 0.5	0.456	22	37	0.595	9.8	0.419	22.9
0.5 - 0.6	0.547	24	47	0.511	12.5		
0.6 - 0.7	0.641	24	39	0.615	10.4	0.558	22.9
0.7 - 0.8	0.747	34	44	0.773	11.7		
0.8 - 0.9	0.849	18	21	0.857	5.6	0.800	17.3
0.9 - 1.0	0.945	14	14	1.000	3.7		
1.0 - 3.0	1.099	23	24	0.958	6.4	0.974	10.1
(-1.0) - 3.0	0.508	183	376	0.487		0.487	

Table A.43. Equations 27 and 16 12Z Radiosonde Cumulonimbus or Precipitation Contingency Tables for June 15 to August 31.

CONTINGENCY TABLE

MONTH: JJA   YEARS: 1970-83   LOCATION: KSLC

EQUATION: 27   TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	378	127	505
C				
	NO	99	460	559
S				
T	TOTAL	477	587	1064

E: 534.8   SS: 0.573   CORRECT: 78.8 %

EQUATION: 16   TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	363	134	497
C				
	NO	114	453	567
S				
T	TOTAL	477	587	1064

E: 535.6   SS: 0.531   CORRECT: 76.7 %

Table A.44. Equation 27 Frequency Table for JJA 1970-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.096	2	59	0.034	5.5		
0.0 - 0.1	0.062	5	72	0.069	6.8	0.053	12.3
0.1 - 0.2	0.150	6	107	0.056	10.1		
0.2 - 0.3	0.249	20	112	0.179	10.5	0.119	20.6
0.3 - 0.4	0.348	35	119	0.294	11.2		
0.4 - 0.5	0.453	31	90	0.344	8.5	0.316	19.6
0.5 - 0.6	0.548	49	101	0.485	9.5		
0.6 - 0.7	0.648	68	106	0.642	10.0	0.565	19.5
0.7 - 0.8	0.742	69	82	0.841	7.7		
0.8 - 0.9	0.844	59	70	0.843	6.6	0.842	14.3
0.9 - 1.0	0.946	40	51	0.784	4.8		
1.0 - 3.0	1.133	93	95	0.979	8.9	0.911	13.7
(-1.0) - 3.0	0.493	477	1064	0.448		0.448	

Table A.45. Equation 16 Frequency Table for JJA 1970-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.069	0	22	0.000	2.1		
0.0 - 0.1	0.057	2	49	0.041	4.6	0.028	6.7
0.1 - 0.2	0.155	5	85	0.059	8.0		
0.2 - 0.3	0.250	14	137	0.102	12.9	0.086	20.9
0.3 - 0.4	0.352	39	142	0.275	13.3		
0.4 - 0.5	0.450	54	132	0.409	12.4	0.339	25.8
0.5 - 0.6	0.548	61	124	0.492	11.7		
0.6 - 0.7	0.644	68	109	0.624	10.2	0.554	21.9
0.7 - 0.8	0.749	91	106	0.858	10.0		
0.8 - 0.9	0.845	55	67	0.821	6.3	0.844	16.3
0.9 - 1.0	0.948	40	42	0.952	3.9		
1.0 - 3.0	1.123	48	49	0.980	4.6	0.967	8.6
(-1.0) - 3.0	0.495	477	1064	0.448		0.448	

Table A.46. Equations 33 and 11 12Z Radiosonde Cumulonimbus or Precipitation Contingency Tables for June 15 to August 31.

CONTINGENCY TABLE

MONTH: JJA YEARS: 1970-78 LOCATION: KSLC

EQUATION: 33 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	206	38	244
C S	NO	78	371	449
T	TOTAL	284	409	693

E: 365.0 SS: 0.646 CORRECT: 83.3 %

EQUATION: 11 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	186	31	217
C S	NO	98	378	476
T	TOTAL	284	409	693

E: 369.9 SS: 0.601 CORRECT: 81.4 %

Table A.47. Equation 33 Frequency Table for JJA 1970-78.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.099	0	74	0.000	10.7		
0.0 - 0.1	0.058	1	55	0.018	7.9	0.008	18.6
0.1 - 0.2	0.153	1	82	0.012	11.8		
0.2 - 0.3	0.249	17	80	0.213	11.5	0.111	23.4
0.3 - 0.4	0.351	26	86	0.302	12.4		
0.4 - 0.5	0.445	33	72	0.458	10.4	0.373	22.8
0.5 - 0.6	0.554	32	49	0.653	7.1		
0.6 - 0.7	0.650	40	48	0.833	6.9	0.742	14.0
0.7 - 0.8	0.751	36	46	0.783	6.6		
0.8 - 0.9	0.845	35	37	0.946	5.3	0.855	12.0
0.9 - 1.0	0.950	23	24	0.958	3.5		
1.0 - 3.0	1.157	40	40	1.000	5.8	0.984	9.2
(-1.0) - 3.0	0.410	284	693	0.410		0.410	

AD-A159 275 A CUMULONIMBUS AND THUNDERSTORM STEPWISE MULTIPLE REGRESSION OBJECTIVE FORECAST STUDY FOR SALT LAKE CITY (U) ARMY DUGWAY PROVING GROUND UT A W WALDRON AUG 85 2/4

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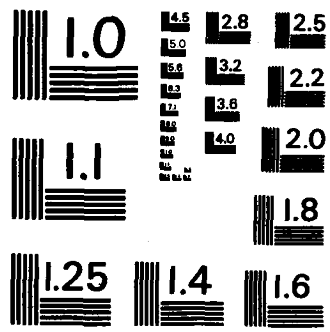

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Table A.48. Equation 11 Frequency Table for JJA 1970-78.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.111	0	88	0.000	12.7		
0.0 - 0.1	0.052	3	75	0.040	10.8	0.018	23.5
0.1 - 0.2	0.151	5	88	0.057	12.7		
0.2 - 0.3	0.252	26	80	0.325	11.5	0.185	24.2
0.3 - 0.4	0.344	31	87	0.356	12.6		
0.4 - 0.5	0.448	33	58	0.569	8.4	0.441	20.9
0.5 - 0.6	0.548	50	64	0.781	9.2		
0.6 - 0.7	0.646	39	51	0.765	7.4	0.774	16.6
0.7 - 0.8	0.743	30	33	0.909	4.8		
0.8 - 0.9	0.854	25	27	0.926	3.9	0.917	8.7
0.9 - 1.0	0.938	16	16	1.000	2.3		
1.0 - 3.0	1.123	26	26	1.000	3.8	1.000	6.1
(-1.0) - 3.0	0.351	284	693	0.410		0.410	

Table A.49. Equations 33 and 11 00Z Radiosonde Cumulonimbus or Precipitation Contingency Tables for June 15 to August 31.

CONTINGENCY TABLE

MONTH: JJA YEARS: 1979-81 LOCATION: KSLC

EQUATION: 33 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	75	18	93
C S	NO	23	112	135
T	TOTAL	98	130	228

E: 116.9 SS: 0.631 CORRECT: 82.0 %

EQUATION: 11 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	67	11	78
C S	NO	31	119	150
T	TOTAL	98	130	228

E: 119.1 SS: 0.614 CORRECT: 81.6 %

Table A.50. Equation 33 Frequency Table for JJA 1979-81.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.071	0	13	0.000	5.7		
0.0 - 0.1	0.053	0	18	0.000	7.9	0.000	13.6
0.1 - 0.2	0.146	4	31	0.129	13.6		
0.2 - 0.3	0.247	3	20	0.150	8.8	0.137	22.4
0.3 - 0.4	0.347	9	34	0.265	14.9		
0.4 - 0.5	0.445	7	19	0.368	8.3	0.302	23.2
0.5 - 0.6	0.539	12	21	0.571	9.2		
0.6 - 0.7	0.647	15	18	0.833	7.9	0.692	17.1
0.7 - 0.8	0.750	14	17	0.824	7.5		
0.8 - 0.9	0.842	6	8	0.750	3.5	0.800	11.0
0.9 - 1.0	0.953	11	11	1.000	4.8		
1.0 - 3.0	1.134	17	18	0.944	7.9	0.966	12.7
(-1.0) - 3.0	0.452	98	228	0.430		0.430	

Table A.51. Equation 11 Frequency Table for JJA 1979-81.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.099	1	26	0.038	11.4		
0.0 - 0.1	0.054	1	24	0.042	10.5	0.040	21.9
0.1 - 0.2	0.156	4	26	0.154	11.4		
0.2 - 0.3	0.247	3	22	0.136	9.6	0.146	21.1
0.3 - 0.4	0.352	11	36	0.306	15.8		
0.4 - 0.5	0.468	11	16	0.688	7.0	0.423	22.8
0.5 - 0.6	0.551	20	27	0.741	11.8		
0.6 - 0.7	0.641	11	12	0.917	5.3	0.795	17.1
0.7 - 0.8	0.740	7	9	0.778	3.9		
0.8 - 0.9	0.857	12	12	1.000	5.3	0.905	9.2
0.9 - 1.0	0.938	6	7	0.857	3.1		
1.0 - 3.0	1.109	11	11	1.000	4.8	0.944	7.9
(-1.0) - 3.0	0.380	98	228	0.430		0.430	

Table A.52. Equations 33 and 11 00Z Radiosonde Cumulonimbus or Precipitation Contingency Tables for June 15 to August 31.

CONTINGENCY TABLE

MONTH: JJA YEARS: 1982-83 LOCATION: KSLC

EQUATION: 33 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	65	23	88
C S	NO	4	51	55
T	TOTAL	69	74	143

E: 70.9 SS: 0.625 CORRECT: 81.1 %

EQUATION: 11 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	60	17	77
C S	NO	9	57	66
T	TOTAL	69	74	143

E: 71.3 SS: 0.637 CORRECT: 81.8 %

Table A.53. Equation 33 Frequency Table for JJA 1982-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.115	0	7	0.000	4.9		
0.0 - 0.1	0.070	0	6	0.000	4.2	0.000	9.1
0.1 - 0.2	0.146	0	6	0.000	4.2		
0.2 - 0.3	0.257	1	16	0.063	11.2	0.045	15.4
0.3 - 0.4	0.366	1	12	0.083	8.4		
0.4 - 0.5	0.474	2	8	0.250	5.6	0.150	14.0
0.5 - 0.6	0.556	8	17	0.471	11.9		
0.6 - 0.7	0.657	9	13	0.692	9.1	0.567	21.0
0.7 - 0.8	0.752	6	11	0.545	7.7		
0.8 - 0.9	0.857	13	14	0.929	9.8	0.760	17.5
0.9 - 1.0	0.951	8	9	0.889	6.3		
1.0 - 3.0	1.157	21	24	0.875	16.8	0.879	23.1
(-1.0) - 3.0	0.611	69	143	0.483		0.483	

Table A.54. Equation 11 Frequency Table for JJA 1982-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.114	0	7	0.000	4.9		
0.0 - 0.1	0.062	0	8	0.000	5.6	0.000	10.5
0.1 - 0.2	0.154	1	10	0.100	7.0		
0.2 - 0.3	0.245	0	15	0.000	10.5	0.040	17.5
0.3 - 0.4	0.362	4	17	0.235	11.9		
0.4 - 0.5	0.458	4	9	0.444	6.3	0.308	18.2
0.5 - 0.6	0.558	7	12	0.583	8.4		
0.6 - 0.7	0.649	14	21	0.667	14.7	0.636	23.1
0.7 - 0.8	0.753	11	13	0.846	9.1		
0.8 - 0.9	0.850	12	13	0.923	9.1	0.885	18.2
0.9 - 1.0	0.937	8	9	0.889	6.3		
1.0 - 3.0	1.107	8	9	0.889	6.3	0.889	12.6
(-1.0) - 3.0	0.523	69	143	0.483		0.483	

Table A.55. Equations 33 and 11 00Z Radiosonde Cumulonimbus or Precipitation Contingency Tables for June 15 to August 31.

CONTINGENCY TABLE

MONTH: JJA YEARS: 1979-83 LOCATION: KSLC

EQUATION: 33 TIME: 00Z

		OBSERVED YES	NO	TOTAL
F	YES	140	41	181
C S	NO	27	163	190
T	TOTAL	167	204	371

E: 185.9 SS: 0.633 CORRECT: 81.7 %

EQUATION: 11 TIME: 00Z

		OBSERVED YES	NO	TOTAL
F	YES	127	28	155
C S	NO	40	176	216
T	TOTAL	167	204	371

E: 188.5 SS: 0.627 CORRECT: 81.7 %

Table A.56. Equation 33 Frequency Table for JJA 1979-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.086	0	20	0.000	5.4		
0.0 - 0.1	0.058	0	24	0.000	6.5	0.000	11.9
0.1 - 0.2	0.146	4	37	0.108	10.0		
0.2 - 0.3	0.252	4	36	0.111	9.7	0.110	19.7
0.3 - 0.4	0.352	10	46	0.217	12.4		
0.4 - 0.5	0.453	9	27	0.333	7.3	0.260	19.7
0.5 - 0.6	0.546	20	38	0.526	10.2		
0.6 - 0.7	0.652	24	31	0.774	8.4	0.638	18.6
0.7 - 0.8	0.751	20	28	0.714	7.5		
0.8 - 0.9	0.851	19	22	0.864	5.9	0.780	13.5
0.9 - 1.0	0.952	19	20	0.950	5.4		
1.0 - 3.0	1.147	38	42	0.905	11.3	0.919	16.7
(-1.0) - 3.0	0.513	167	371	0.450		0.450	

Table A.57. Equation 11 Frequency Table for JJA 1979-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.102	1	33	0.030	8.9		
0.0 - 0.1	0.056	1	32	0.031	8.6	0.031	17.5
0.1 - 0.2	0.155	5	36	0.139	9.7		
0.2 - 0.3	0.246	3	37	0.081	10.0	0.110	19.7
0.3 - 0.4	0.355	15	53	0.283	14.3		
0.4 - 0.5	0.464	15	25	0.600	6.7	0.385	21.0
0.5 - 0.6	0.553	27	39	0.692	10.5		
0.6 - 0.7	0.646	25	33	0.758	8.9	0.722	19.4
0.7 - 0.8	0.748	18	22	0.818	5.9		
0.8 - 0.9	0.853	24	25	0.960	6.7	0.894	12.7
0.9 - 1.0	0.937	14	16	0.875	4.3		
1.0 - 3.0	1.108	19	20	0.950	5.4	0.917	9.7
(-1.0) - 3.0	0.435	167	371	0.450		0.450	

Table A.58. Equations 33 and 11 00Z Radiosonde Cumulonimbus or Precipitation Contingency Tables for June 15 to August 31.

CONTINGENCY TABLE

MONTH: JJA YEARS: 1970-83 LOCATION: KSLC

EQUATION: 33 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	346	79	425
C S	NO	105	534	639
T	TOTAL	451	613	1064

E: 548.3 SS: 0.643 CORRECT: 82.7 %

EQUATION: 11 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	313	59	372
C S	NO	138	554	692
T	TOTAL	451	613	1064

E: 556.4 SS: 0.612 CORRECT: 81.5 %

Table A.59. Equation 33 Frequency Table for JJA 1970-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.096	0	94	0.000	8.8		
0.0 - 0.1	0.058	1	79	0.013	7.4	0.006	16.3
0.1 - 0.2	0.151	5	119	0.042	11.2		
0.2 - 0.3	0.250	21	116	0.181	10.9	0.111	22.1
0.3 - 0.4	0.351	36	132	0.273	12.4		
0.4 - 0.5	0.447	42	99	0.424	9.3	0.338	21.7
0.5 - 0.6	0.551	52	87	0.598	8.2		
0.6 - 0.7	0.651	64	79	0.810	7.4	0.699	15.6
0.7 - 0.8	0.751	56	74	0.757	7.0		
0.8 - 0.9	0.847	54	59	0.915	5.5	0.827	12.5
0.9 - 1.0	0.951	42	44	0.955	4.1		
1.0 - 3.0	1.152	78	82	0.951	7.7	0.952	11.8
(-1.0) - 3.0	0.446	451	1064	0.424		0.424	

Table B.12. Equation 44 Frequency Table for MJS 1979-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.084	1	40	0.025	11.1		
0.0 - 0.1	0.050	4	89	0.045	24.7	0.039	35.7
0.1 - 0.2	0.159	8	64	0.125	17.7		
0.2 - 0.3	0.247	12	63	0.190	17.5	0.157	35.2
0.3 - 0.4	0.350	13	42	0.310	11.6		
0.4 - 0.5	0.443	12	39	0.308	10.8	0.309	22.4
0.5 - 0.6	0.545	11	22	0.500	6.1		
0.6 - 0.7	0.608	1	2	0.500	0.6	0.500	6.6
(-1.0) - 3.0	0.200	62	361	0.172		0.172	

Table B.11. Equation 37 Frequency Table for MJS 1979-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.207	1	35	0.029	9.7		
0.0 - 0.1	0.048	1	25	0.040	6.9	0.033	16.6
0.1 - 0.2	0.149	5	40	0.125	11.1		
0.2 - 0.3	0.256	5	53	0.094	14.7	0.108	25.8
0.3 - 0.4	0.353	5	46	0.109	12.7		
0.4 - 0.5	0.455	11	57	0.193	15.8	0.155	28.5
0.5 - 0.6	0.549	6	30	0.200	8.3		
0.6 - 0.7	0.651	12	33	0.364	9.1	0.286	17.5
0.7 - 0.8	0.734	5	18	0.278	5.0		
0.8 - 0.9	0.827	5	11	0.455	3.0	0.345	8.0
0.9 - 1.0	0.956	6	10	0.600	2.8		
1.0 - 3.0	1.121	0	3	0.000	0.8	0.462	3.6
(-1.0) - 3.0	0.357	62	361	0.172		0.172	

Table B.10. Equations 37 and 44 12Z Radiosonde Thunder Independent Data Contingency Tables for May 1 to June 14 and September.

CONTINGENCY TABLE

MONTH: MJS YEARS: 1979-83 LOCATION: KSLC

EQUATION: 37 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	28	47	75
C S	NO	34	252	286
T	TOTAL	62	299	361

E: 249.8 SS: 0.272 CORRECT: 77.6 %

EQUATION: 44 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	30	56	86
C S	NO	32	243	275
T	TOTAL	62	299	361

E: 242.5 SS: 0.257 CORRECT: 75.6 %

Table B.9. Equation 44 Frequency Table for MJS 1982-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.123	0	16	0.000	10.9		
0.0 - 0.1	0.049	3	32	0.094	21.8	0.063	32.7
0.1 - 0.2	0.168	3	25	0.120	17.0		
0.2 - 0.3	0.252	5	32	0.156	21.8	0.140	38.8
0.3 - 0.4	0.357	5	17	0.294	11.6		
0.4 - 0.5	0.442	6	19	0.316	12.9	0.306	24.5
0.5 - 0.6	0.560	3	6	0.500	4.1	0.500	4.1
(-1.0) - 3.0	0.202	25	147	0.170		0.170	

Table B.8. Equation 37 Frequency Table for MJS 1982-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.241	1	28	0.036	19.0		
0.0 - 0.1	0.044	1	9	0.111	6.1	0.054	25.2
0.1 - 0.2	0.147	2	16	0.125	10.9		
0.2 - 0.3	0.258	3	18	0.167	12.2	0.147	23.1
0.3 - 0.4	0.346	1	12	0.083	8.2		
0.4 - 0.5	0.455	3	19	0.158	12.9	0.129	21.1
0.5 - 0.6	0.531	4	12	0.333	8.2		
0.6 - 0.7	0.649	2	15	0.133	10.2	0.222	18.4
0.7 - 0.8	0.736	4	9	0.444	6.1		
0.8 - 0.9	0.831	2	4	0.500	2.7	0.462	8.8
0.9 - 1.0	0.961	2	2	1.000	1.4		
1.0 - 3.0	1.121	0	3	0.000	2.0	0.400	3.4
(-1.0) - 3.0	0.305	25	147	0.170		0.170	

Table B.7. Equations 37 and 44 12Z Radiosonde Thunder Independent Data Contingency Tables for May 1 to June 14 and September.

CONTINGENCY TABLE

MONTH: MJS YEARS: 1982-83 LOCATION: KSLC

EQUATION: 37 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	10	23	33
C S	NO	15	99	114
T	TOTAL	25	122	147

E: 100.2 SS: 0.188 CORRECT: 74.1 %

EQUATION: 44 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	13	24	37
C S	NO	12	98	110
T	TOTAL	25	122	147

E: 97.6 SS: 0.271 CORRECT: 75.5 %

Table B.6. Equation 44 Frequency Table for MJS 1979-81.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.058	1	24	0.042	11.2		
0.0 - 0.1	0.051	1	57	0.018	26.6	0.025	37.9
0.1 - 0.2	0.154	5	39	0.128	18.2		
0.2 - 0.3	0.242	7	31	0.226	14.5	0.171	32.7
0.3 - 0.4	0.345	8	25	0.320	11.7		
0.4 - 0.5	0.444	6	20	0.300	9.3	0.311	21.0
0.5 - 0.6	0.539	8	16	0.500	7.5		
0.6 - 0.7	0.608	1	2	0.500	0.9	0.500	8.4
(-1.0) - 3.0	0.198	37	214	0.173		0.173	

Table B.5. Equation 37 Frequency Table for MJS 1979-81.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.073	0	7	0.000	3.3		
0.0 - 0.1	0.051	0	16	0.000	7.5	0.000	10.7
0.1 - 0.2	0.151	3	24	0.125	11.2		
0.2 - 0.3	0.255	2	35	0.057	16.4	0.085	27.6
0.3 - 0.4	0.356	4	34	0.118	15.9		
0.4 - 0.5	0.455	8	38	0.211	17.8	0.167	33.6
0.5 - 0.6	0.561	2	18	0.111	8.4		
0.6 - 0.7	0.653	10	18	0.556	8.4	0.333	16.8
0.7 - 0.8	0.732	1	9	0.111	4.2		
0.8 - 0.9	0.824	3	7	0.429	3.3	0.250	7.5
0.9 - 3.0	0.955	4	8	0.500	3.7	0.500	3.7
(-1.0) - 3.0	0.393	37	214	0.173		0.173	

Table B.4. Equations 37 and 44 12Z Radiosonde Thunder Independent Data Contingency Tables for May 1 to June 14 and September.

CONTINGENCY TABLE

MONTH: MJS YEARS: 1979-81 LOCATION: KSLC

EQUATION: 37 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	18	24	42
C				
	NO	19	153	172
S				
T	TOTAL	37	177	214

E: 149.5 SS: 0.333 CORRECT: 79.9 %

EQUATION: 44 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	17	32	49
C				
	NO	20	145	165
S				
T	TOTAL	37	177	214

E: 144.9 SS: 0.247 CORRECT: 75.7 %

Table B.3. Equation 44 Frequency Table for MJS 1970-78.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.069	0	123	0.000	18.9		
0.0 - 0.1	0.048	4	137	0.029	21.0	0.015	39.9
0.1 - 0.2	0.146	11	145	0.076	22.3		
0.2 - 0.3	0.248	23	113	0.204	17.4	0.132	39.6
0.3 - 0.4	0.347	25	72	0.347	11.1		
0.4 - 0.5	0.441	28	43	0.651	6.6	0.461	17.7
0.5 - 0.6	0.547	9	16	0.563	2.5		
0.6 - 0.7	0.635	1	2	0.500	0.3	0.556	2.8
(-1.0) - 3.0	0.155	101	651	0.155		0.155	

Table B.2. Equation 37 Frequency Table for MJS 1970-78.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.018	0	47	0.000	7.2		
0.0 - 0.1	0.050	1	41	0.024	6.3	0.011	13.5
0.1 - 0.2	0.151	0	65	0.000	10.0		
0.2 - 0.3	0.252	4	84	0.048	12.9	0.027	22.9
0.3 - 0.4	0.344	10	99	0.101	15.2		
0.4 - 0.5	0.445	9	87	0.103	13.4	0.102	28.6
0.5 - 0.6	0.549	17	68	0.250	10.4		
0.6 - 0.7	0.643	23	75	0.307	11.5	0.280	22.0
0.7 - 0.8	0.747	19	39	0.487	6.0		
0.8 - 0.9	0.844	10	26	0.385	4.0	0.446	10.0
0.9 - 1.0	0.946	6	11	0.545	1.7		
1.0 - 3.0	1.114	2	9	0.222	1.4	0.400	3.1
(-1.0) - 3.0	0.395	101	651	0.155		0.155	

Table B.1. Equations 37 and 44 12Z Radiosonde Thunder Dependent Data Contingency Tables for May 1 to June 14 and September.

CONTINGENCY TABLE

MONTH: MJS YEARS: 1970-78 LOCATION: KSLC

EQUATION: 37 TIME: 12Z

OBSERVED

		YES	NO	TOTAL
F	YES	60	100	160
C				
	NO	41	487	528
S				
T	TOTAL	101	587	688

E: 474.0 SS: 0.341 CORRECT: 79.5 %

EQUATION: 44 TIME: 12Z

OBSERVED

		YES	NO	TOTAL
F	YES	55	39	94
C				
	NO	46	548	594
S				
T	TOTAL	101	587	688

E: 520.6 SS: 0.492 CORRECT: 87.6 %

APPENDIX B

THUNDER FORECAST CONTINGENCY AND PROBABILITY TABLES

Table A.60. Equation 11 Frequency Table for JJA 1970-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.109	1	121	0.008	11.4		
0.0 - 0.1	0.053	4	107	0.037	10.1	0.022	21.4
0.1 - 0.2	0.152	10	124	0.081	11.7		
0.2 - 0.3	0.250	29	117	0.248	11.0	0.162	22.7
0.3 - 0.4	0.348	46	140	0.329	13.2		
0.4 - 0.5	0.453	48	83	0.578	7.8	0.422	21.0
0.5 - 0.6	0.550	77	103	0.748	9.7		
0.6 - 0.7	0.646	64	84	0.762	7.9	0.754	17.6
0.7 - 0.8	0.745	48	55	0.873	5.2		
0.8 - 0.9	0.854	49	52	0.942	4.9	0.907	10.1
0.9 - 1.0	0.938	30	32	0.938	3.0		
1.0 - 3.0	1.116	45	46	0.978	4.3	0.962	7.3
(-1.0) - 3.0	0.380	451	1064	0.424		0.424	

Table B.13. Equations 37 and 44 12Z Radiosonde Thunder Contingency Tables for May 1 to June 14 and September.

CONTINGENCY TABLE

MONTH: MJS YEARS: 1970-83 LOCATION: KSLC

EQUATION: 37 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	88	147	235
C				
	NO	75	702	777
S				
T	TOTAL	163	849	1012

E: 689.7 SS: 0.311 CORRECT: 78.1 %

EQUATION: 44 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	85	95	180
C				
	NO	78	754	832
S				
T	TOTAL	163	849	1012

E: 727.0 SS: 0.393 CORRECT: 82.9 %

Table B.14. Equation 37 Frequency Table for MJS 1970-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.156	1	82	0.012	8.1		
0.0 - 0.1	0.049	2	66	0.030	6.5	0.020	14.6
0.1 - 0.2	0.150	5	105	0.048	10.4		
0.2 - 0.3	0.254	9	137	0.066	13.5	0.058	23.9
0.3 - 0.4	0.347	15	145	0.103	14.3		
0.4 - 0.5	0.449	20	144	0.139	14.2	0.121	28.6
0.5 - 0.6	0.549	23	98	0.235	9.7		
0.6 - 0.7	0.646	35	108	0.324	10.7	0.282	20.4
0.7 - 0.8	0.743	24	57	0.421	5.6		
0.8 - 0.9	0.839	15	37	0.405	3.7	0.415	9.3
0.9 - 1.0	0.951	12	21	0.571	2.1		
1.0 - 3.0	1.116	2	12	0.167	1.2	0.424	3.3
(-1.0) - 3.0	0.382	163	1012	0.161		0.161	

Table B.15. Equation 44 Frequency Table for MJS 1970-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
-1.00 - -0.001	-0.073	1	163	0.006	16.1		
0.00 - 0.049	0.024	4	118	0.034	11.7	0.018	27.8
0.05 - 0.099	0.076	4	108	0.037	10.7		
0.10 - 0.149	0.125	7	102	0.069	10.1	0.052	20.8
0.15 - 0.199	0.174	12	107	0.112	10.6		
0.20 - 0.249	0.223	21	88	0.239	8.7	0.169	19.3
0.25 - 0.299	0.271	14	88	0.159	8.7		
0.30 - 0.349	0.326	15	58	0.259	5.7	0.199	14.4
0.35 - 0.399	0.371	23	56	0.411	5.5		
0.40 - 0.499	0.442	40	82	0.488	8.1	0.457	13.6
0.50 - 0.700	0.553	22	42	0.524	4.2	0.524	4.2
-1.00 - 0.700	0.171	163	1012	0.161		0.161	

Table B.16. Equations 21 and 45 00Z Radiosonde Thunder Contingency Tables for May 1 to June 14 and September.

CONTINGENCY TABLE

MONTH: MJS YEARS: 1970-78 LOCATION: KSLC

EQUATION: 21 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	35	66	101
C S	NO	57	514	571
T	TOTAL	92	580	672

E: 506.7 SS: 0.256 CORRECT: 81.7 %

EQUATION: 45 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	42	34	76
C S	NO	50	546	596
T	TOTAL	92	580	672

E: 524.8 SS: 0.429 CORRECT: 87.5 %

Table B.17. Equation 21 Frequency Table for MJS 1970-78.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.165	0	113	0.000	16.8		
0.0 - 0.1	0.054	0	46	0.000	6.8	0.000	23.7
0.1 - 0.2	0.150	2	71	0.028	10.6		
0.2 - 0.3	0.254	3	79	0.038	11.8	0.033	22.3
0.3 - 0.4	0.347	18	107	0.168	15.9		
0.4 - 0.5	0.451	17	76	0.224	11.3	0.191	27.2
0.5 - 0.6	0.550	17	79	0.215	11.8		
0.6 - 0.7	0.649	13	51	0.255	7.6	0.231	19.3
0.7 - 0.8	0.743	10	30	0.333	4.5		
0.8 - 0.9	0.845	4	10	0.400	1.5	0.350	6.0
0.9 - 1.0	0.947	6	8	0.750	1.2		
1.0 - 3.0	1.054	2	2	1.000	0.3	0.800	1.5
-1.0 - 3.0	0.302	92	672	0.137		0.137	

Table B.18. Equation 45 Frequency Table for MJS 1970-78.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
-1.00 - -0.001	-.055	2	156	0.013	23.2	0.008	36.6
0.00 - 0.049	0.026	0	90	0.000	13.4		
0.05 - 0.099	0.077	0	76	0.000	11.3	0.026	22.9
0.10 - 0.149	0.124	4	78	0.051	11.6		
0.15 - 0.199	0.174	7	61	0.115	9.1	0.165	17.1
0.20 - 0.249	0.223	12	54	0.222	8.0		
0.25 - 0.299	0.273	13	47	0.277	7.0	0.309	12.1
0.30 - 0.349	0.320	12	34	0.353	5.1		
0.35 - 0.399	0.373	7	24	0.292	3.6	0.511	6.7
0.40 - 0.499	0.431	16	21	0.762	3.1		
0.50 - 0.699	0.561	16	26	0.615	3.9	0.613	4.6
0.70 - 3.000	0.767	3	5	0.600	0.7		
0.70 - 3.000	0.137	92	672	0.137	100.0	0.137	100.0

Table B.19. Equations 21 and 45 00Z Radiosonde Thunder Contingency Tables for May 1 to June 14 and September.

CONTINGENCY TABLE

MONTH: MJS YEARS: 1979-81 LOCATION: KSLC

EQUATION: 21 TIME: 00Z

		OBSERVED YES	NO	TOTAL
F	YES	24	21	45
C S	NO	6	163	169
T	TOTAL	30	184	214

E: 151.6 SS: 0.567 CORRECT: 87.4 %

EQUATION: 45 TIME: 00Z

		OBSERVED YES	NO	TOTAL
F	YES	18	27	45
C S	NO	12	157	169
T	TOTAL	30	184	214

E: 151.6 SS: 0.375 CORRECT: 81.8 %

Table B.20. Equation 21 Frequency Table for MJS 1979-81.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.134	0	19	0.000	8.9		
0.0 - 0.1	0.055	0	15	0.000	7.0	0.000	15.9
0.1 - 0.2	0.153	0	18	0.000	8.4		
0.2 - 0.3	0.241	0	27	0.000	12.6	0.000	21.0
0.3 - 0.4	0.345	0	32	0.000	15.0		
0.4 - 0.5	0.451	4	33	0.121	15.4	0.062	30.4
0.5 - 0.6	0.541	2	25	0.080	11.7		
0.6 - 0.7	0.652	10	19	0.526	8.9	0.273	20.6
0.7 - 0.8	0.750	9	18	0.500	8.4		
0.8 - 0.9	0.825	4	7	0.571	3.3	0.520	11.7
0.9 - 3.0	0.908	1	1	1.000	0.5	1.000	0.5
-1.0 - 3.0	0.372	30	214	0.140		0.140	

Table B.21. Equation 45 Frequency Table for MJS 1979-81.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
-1.00 - -0.001	-0.067	0	29	0.000	13.6		
0.00 - 0.049	0.027	0	17	0.000	7.9	0.000	21.5
0.05 - 0.099	0.073	0	30	0.000	14.0		
0.10 - 0.149	0.120	2	23	0.087	10.7	0.038	24.8
0.15 - 0.199	0.167	0	22	0.000	10.3		
0.20 - 0.249	0.217	1	20	0.050	9.3	0.024	19.6
0.25 - 0.299	0.276	6	14	0.429	6.5		
0.30 - 0.349	0.329	3	14	0.214	6.5	0.321	13.1
0.35 - 0.399	0.374	4	12	0.333	5.6		
0.40 - 0.499	0.449	9	21	0.429	9.8	0.394	15.4
0.50 - 0.699	0.589	2	8	0.250	3.7		
0.70 - 0.900	0.802	3	4	0.750	1.9	0.417	5.6
-1.00 - 0.900	0.195	30	214	0.140		0.140	

Table B.22. Equations 21 and 45 00Z Radiosonde Thunder Contingency Tables for May 1 to June 14 and September.

CONTINGENCY TABLE

MONTH: MJS YEARS: 1982-83 LOCATION: KSLC

EQUATION: 21 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	7	22	29
C S	NO	11	99	110
T	TOTAL	18	121	139

E: 99.5 SS: 0.164 CORRECT: 76.3 %

EQUATION: 45 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	8	17	25
C S	NO	10	104	114
T	TOTAL	18	121	139

E: 102.5 SS: 0.261 CORRECT: 80.6 %

Table B.23. Equation 21 Frequency Table for MJS 1982-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-.161	0	13	0.000	9.4		
0.0 - 0.1	0.035	0	9	0.000	6.5	0.000	15.8
0.1 - 0.2	0.143	0	10	0.000	7.2		
0.2 - 0.3	0.240	1	17	0.059	12.2	0.037	19.4
0.3 - 0.4	0.351	2	14	0.143	10.1		
0.4 - 0.5	0.452	1	24	0.042	17.3	0.079	27.3
0.5 - 0.6	0.553	7	23	0.304	16.5		
0.6 - 0.7	0.649	2	15	0.133	10.8	0.237	27.3
0.7 - 0.8	0.762	0	8	0.000	5.8		
0.8 - 0.9	0.860	4	5	0.800	3.6	0.308	9.4
0.9 - 3.0	0.949	1	1	1.000	0.7	1.000	0.7
-1.0 - 3.0	0.383	18	139	0.129		0.129	

Table B.24. Equation 45 Frequency Table for MJS 1982-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
-1.00 - -0.001	-0.063	0	12	0.000	8.6		
0.00 - 0.049	0.021	1	16	0.063	11.5	0.036	20.1
0.05 - 0.099	0.075	1	14	0.071	10.1		
0.10 - 0.149	0.120	1	16	0.063	11.5	0.067	21.6
0.15 - 0.199	0.176	0	8	0.000	5.8		
0.20 - 0.249	0.228	3	18	0.167	12.9	0.115	18.7
0.25 - 0.299	0.277	2	14	0.143	10.1		
0.30 - 0.349	0.327	2	15	0.133	10.8	0.138	20.9
0.35 - 0.399	0.364	1	7	0.143	5.0		
0.40 - 0.499	0.441	2	8	0.250	5.8	0.200	10.8
0.50 - 0.699	0.609	3	9	0.333	6.5		
0.70 - 3.000	1.016	2	2	1.000	1.4	0.455	7.9
-1.00 - 3.000	0.219	18	139	0.129		0.129	

Table B.25. Equations 21 and 45 00Z Radiosonde Thunder Contingency Tables for May 1 to June 14 and September.

CONTINGENCY TABLE

MONTH: MJS YEARS: 1979-83 LOCATION: KSLC

EQUATION: 21 TIME: 00Z

		OBSERVED YES	NO	TOTAL
F	YES	31	43	74
C S	NO	17	262	279
T	TOTAL	48	305	353

E: 251.1 SS: 0.411 CORRECT: 83.0 %

EOUATION: 45 TIME: 00Z

		OBSERVED YES	NO	TOTAL
F	YES	26	44	70
C S	NO	22	261	283
T	TOTAL	48	305	353

E: 254.0 SS: 0.333 CORRECT: 81.3 %

Table B.26. Equation 21 Frequency Table for MJS 1979-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.145	0	32	0.000	9.1		
0.0 - 0.1	0.047	0	24	0.000	6.8	0.000	15.9
0.1 - 0.2	0.150	0	28	0.000	7.9		
0.2 - 0.3	0.241	1	44	0.023	12.5	0.014	20.4
0.3 - 0.4	0.346	2	46	0.043	13.0		
0.4 - 0.5	0.451	5	57	0.088	16.1	0.068	29.2
0.5 - 0.6	0.547	9	48	0.188	13.6		
0.6 - 0.7	0.650	12	34	0.353	9.6	0.256	23.2
0.7 - 0.8	0.754	9	26	0.346	7.4		
0.8 - 0.9	0.839	8	12	0.667	3.4	0.447	10.8
0.9 - 3.0	0.928	2	2	1.000	0.6	1.000	0.6
-1.0 - 3.0	0.376	48	353	0.136		0.136	

Table B.40. Equations 41 and 46 12Z Radiosonde Thunder Independent Data Contingency Tables for June 15 to August 31.

CONTINGENCY TABLE

MONTH: JJA YEARS: 1979-83 LOCATION: KSLC

EQUATION: 41 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	44	63	107
C				
	NO	31	238	269
S				
T	TOTAL	75	301	376

E: 236.7 SS: 0.325 CORRECT: 75.0 %

EQUATION: 46 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	45	58	103
C				
	NO	30	243	273
S				
T	TOTAL	75	301	376

E: 239.1 SS: 0.357 CORRECT: 76.6 %

Table B.39. Equation 46 Frequency Table for JJA 1982-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
-1.00 - -0.001	-0.118	1	21	0.048	14.1	0.040	16.8
0.00 - 0.049	0.028	0	4	0.000	2.7		
0.05 - 0.099	0.079	0	10	0.000	6.7	0.032	20.8
0.10 - 0.199	0.149	1	21	0.048	14.1		
0.20 - 0.299	0.253	10	25	0.400	16.8	0.300	33.6
0.30 - 0.399	0.351	5	25	0.200	16.8		
0.40 - 0.499	0.433	4	15	0.267	10.1	0.346	17.4
0.50 - 0.599	0.554	5	11	0.455	7.4		
0.60 - 0.699	0.638	3	8	0.375	5.4	0.625	10.7
0.70 - 0.799	0.752	7	8	0.875	5.4		
0.80 - 0.900	0.817	1	1	1.000	0.7		
-1.00 - 0.900	0.276	37	149	0.248	100.0	0.248	100.0

Table B.38. Equation 41 Frequency Table for JJA 1982-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.229	2	21	0.095	14.1		
0.0 - 0.1	0.076	0	10	0.000	6.7	0.065	20.8
0.1 - 0.2	0.145	0	8	0.000	5.4		
0.2 - 0.3	0.245	2	7	0.286	4.7	0.133	10.1
0.3 - 0.4	0.348	1	13	0.077	8.7		
0.4 - 0.5	0.441	5	16	0.313	10.7	0.207	19.5
0.5 - 0.6	0.548	6	22	0.273	14.8		
0.6 - 0.7	0.652	5	19	0.263	12.8	0.268	27.5
0.7 - 0.8	0.742	6	20	0.300	13.4		
0.8 - 0.9	0.846	6	7	0.857	4.7	0.444	18.1
0.9 - 1.0	0.935	1	3	0.333	2.0		
1.0 - 3.0	1.068	3	3	1.000	2.0	0.667	4.0
-1.0 - 3.0	0.414	37	149	0.248		0.248	

Table B.37. Equations 41 and 46 12Z Radiosonde Thunder Independent Data Contingency Tables for June 15 to August 31.

CONTINGENCY TABLE

MONTH: JJA YEARS: 1982-83 LOCATION: KSLC

EQUATION: 41 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	21	31	52
C S	NO	16	81	97
T	TOTAL	37	112	149

E: 85.8 SS: 0.256 CORRECT: 68.5 %

EQUATION: 46 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	23	35	58
C S	NO	14	77	91
T	TOTAL	37	112	149

E: 82.8 SS: 0.260 CORRECT: 67.1 %

Table B.36. Equation 46 Frequency Table for JJA 1979-81.

ONE TENTH R CLASS LIMITS		MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
-1.00 -	-0.001	-0.057	0	43	0.000	18.9		
0.00 -	0.049	0.028	1	23	0.043	10.1	0.015	29.1
0.05 -	0.099	0.075	3	21	0.143	9.3		
0.10 -	0.199	0.141	4	45	0.089	19.8	0.106	29.1
0.20 -	0.299	0.251	5	37	0.135	16.3		
0.30 -	0.399	0.341	5	19	0.263	8.4	0.179	24.7
0.40 -	0.499	0.441	8	18	0.444	7.9		
0.50 -	0.599	0.545	5	12	0.417	5.3	0.433	13.2
0.60 -	0.699	0.628	3	5	0.600	2.2		
0.70 -	0.799	0.725	3	3	1.000	1.3	0.750	3.5
0.80 -	0.900	0.852	1	1	1.000	0.4		
-1.00 -	0.900	0.187	38	227	0.167	100.0	0.167	100.0

Table B.35. Equation 41 Frequency Table for JJA 1979-81.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.059	0	12	0.000	5.3		
0.0 - 0.1	0.057	0	17	0.000	7.5	0.000	12.8
0.1 - 0.2	0.150	2	32	0.063	14.1		
0.2 - 0.3	0.247	2	31	0.065	13.7	0.063	27.8
0.3 - 0.4	0.353	5	36	0.139	15.9		
0.4 - 0.5	0.453	2	31	0.065	13.7	0.104	29.5
0.5 - 0.6	0.533	4	13	0.308	5.7		
0.6 - 0.7	0.643	11	26	0.423	11.5	0.385	17.2
0.7 - 0.8	0.738	3	16	0.188	7.0		
0.8 - 0.9	0.830	3	4	0.750	1.8	0.300	8.8
0.9 - 1.0	0.927	1	4	0.250	1.8		
1.0 - 3.0	1.101	5	5	1.000	2.2	0.667	4.0
-1.0 - 3.0	0.385	38	227	0.167		0.167	

Table B.34. Equations 41 and 46 12Z Radiosonde Thunder Independent Data Contingency Tables for June 15 to August 31.

CONTINGENCY TABLE

MONTH: JJA YEARS: 1979-81 LOCATION: KSLC

EQUATION: 41 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	23	32	55
C S	NO	15	157	172
T	TOTAL	38	189	227

E: 152.4 SS: 0.370 CORRECT: 79.3 %

EQUATION: 46 TIME: 12Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	22	23	45
C S	NO	16	166	182
T	TOTAL	38	189	227

E: 159.1 SS: 0.426 CORRECT: 82.8 %

Table B.33. Equation 46 Frequency Table for JJA 1970-78.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
-1.00 - -0.001	-0.062	0	131	0.000	19.0		
0.00 - 0.049	0.023	2	79	0.025	11.5	0.010	30.5
0.05 - 0.099	0.077	4	74	0.054	10.8		
0.10 - 0.199	0.148	10	128	0.078	18.6	0.069	29.4
0.20 - 0.299	0.252	16	83	0.193	12.1		
0.30 - 0.399	0.345	32	89	0.360	12.9	0.279	25.0
0.40 - 0.499	0.450	20	38	0.526	5.5		
0.50 - 0.599	0.541	19	35	0.543	5.1	0.534	10.6
0.60 - 0.699	0.638	16	22	0.727	3.2		
0.70 - 0.799	0.741	3	3	1.000	0.4	0.760	3.6
0.80 - 0.900	0.833	5	6	0.833	0.9		
-1.00 - 0.900	0.185	127	688	0.185	100.0	0.185	100.0

Table B.32. Equation 41 Frequency Table for JJA 1970-78.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.096	0	35	0.000	5.1		
0.0 - 0.1	0.054	0	61	0.000	8.9	0.000	14.0
0.1 - 0.2	0.149	0	77	0.000	11.2		
0.2 - 0.3	0.252	7	91	0.077	13.2	0.042	24.4
0.3 - 0.4	0.349	11	125	0.088	18.2		
0.4 - 0.5	0.445	18	91	0.198	13.2	0.134	31.4
0.5 - 0.6	0.545	22	81	0.272	11.8		
0.6 - 0.7	0.653	18	43	0.419	6.3	0.323	18.0
0.7 - 0.8	0.750	20	42	0.476	6.1		
0.8 - 0.9	0.836	11	18	0.611	2.6	0.517	8.7
0.9 - 1.0	0.941	13	16	0.813	2.3		
1.0 - 3.0	1.049	7	8	0.875	1.2	0.833	3.5
-1.0 - 3.0	0.379	127	688	0.185		0.185	

Table B.31. Equations 41 and 46 12Z Radiosonde Thunder Dependent Data Contingency Tables for June 15 to August 31.

CONTINGENCY TABLE

MONTH: JJA YEARS: 1970-78 LOCATION: KSLC

EQUATION: 41 TIME: 12Z

OBSERVED

		YES	NO	TOTAL
F	YES	69	58	127
C				
	NO	58	503	561
S				
T	TOTAL	127	561	688

E: 480.9 SS: 0.440 CORRECT: 83.1 %

EQUATION: 46 TIME: 12Z

OBSERVED

		YES	NO	TOTAL
F	YES	82	62	144
C				
	NO	45	499	544
S				
T	TOTAL	127	561	688

E: 470.2 SS: 0.509 CORRECT: 84.4 %

Table B.30. Equation 45 Frequency Table for MJS 1970-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
-1.00 - -0.001	-0.058	2	197	0.010	19.2		
0.00 - 0.049	0.026	1	123	0.008	12.0	0.009	31.2
0.05 - 0.099	0.076	1	120	0.008	11.7		
0.10 - 0.149	0.123	7	117	0.060	11.4	0.034	23.1
0.15 - 0.199	0.173	7	91	0.077	8.9		
0.20 - 0.249	0.223	16	92	0.174	9.0	0.126	17.9
0.25 - 0.299	0.274	21	75	0.280	7.3		
0.30 - 0.349	0.324	17	63	0.270	6.1	0.275	13.5
0.35 - 0.399	0.372	12	43	0.279	4.2		
0.40 - 0.499	0.440	27	50	0.540	4.9	0.419	9.1
0.50 - 0.699	0.576	21	43	0.488	4.2		
0.70 - 3.000	0.825	8	11	0.727	1.1	0.537	5.3
-1.00 - 3.000	0.160	140	1025	0.137		0.137	

Table B.29. Equation 21 Frequency Table for MJS 1970-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.161	0	145	0.000	14.1		
0.0 - 0.1	0.052	0	70	0.000	6.8	0.000	21.0
0.1 - 0.2	0.150	2	99	0.020	9.7		
0.2 - 0.3	0.249	4	123	0.033	12.0	0.027	21.7
0.3 - 0.4	0.347	20	153	0.131	14.9		
0.4 - 0.5	0.451	22	133	0.165	13.0	0.147	27.9
0.5 - 0.6	0.549	26	127	0.205	12.4		
0.6 - 0.7	0.650	25	85	0.294	8.3	0.241	20.7
0.7 - 0.8	0.748	19	56	0.339	5.5		
0.8 - 0.9	0.842	12	22	0.545	2.1	0.397	7.6
0.9 - 1.0	0.944	8	10	0.800	1.0		
1.0 - 3.0	1.054	2	2	1.000	0.2	0.833	1.2
-1.0 - 3.0	0.328	140	1025	0.137		0.137	

Table B.28. Equations 21 and 45 00Z Radiosonde Thunder Contingency Tables for May 1 to June 14 and September.

CONTINGENCY TABLE

MONTH: MJS   YEARS: 1970-83   LOCATION: KSLC

EQUATION: 21   TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	66	109	175
C				
	NO	74	776	850
S				
T	TOTAL	140	885	1025

E: 757.8   SS: 0.315   CORRECT: 82.1 %

EQUATION: 45   TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	68	78	146
C				
	NO	72	807	879
S				
T	TOTAL	140	885	1025

E: 778.9   SS: 0.391   CORRECT: 85.4 %

Table B.27. Equation 45 Frequency Table for MJS 1979-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
-1.00 - -0.001	-0.066	0	41	0.000	11.6		
0.00 - 0.049	0.024	1	33	0.030	9.3	0.014	21.0
0.05 - 0.099	0.074	1	44	0.023	12.5		
0.10 - 0.149	0.120	3	39	0.077	11.0	0.048	23.5
0.15 - 0.199	0.169	0	30	0.000	8.5		
0.20 - 0.249	0.222	4	38	0.105	10.8	0.059	19.3
0.25 - 0.299	0.277	8	28	0.286	7.9		
0.30 - 0.349	0.328	5	29	0.172	8.2	0.228	16.1
0.35 - 0.399	0.370	5	19	0.263	5.4		
0.40 - 0.499	0.447	11	29	0.379	8.2	0.333	13.6
0.50 - 0.699	0.600	5	17	0.294	4.8		
0.70 - 3.000	0.873	5	6	0.833	1.7	0.435	6.5
-1.00 - 3.000	0.205	48	353	0.136		0.136	

Table B.41. Equation 41 Frequency Table for JJA 1979-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.167	2	33	0.061	8.8		
0.0 - 0.1	0.064	0	27	0.000	7.2	0.033	16.0
0.1 - 0.2	0.149	2	40	0.050	10.6		
0.2 - 0.3	0.246	4	38	0.105	10.1	0.077	20.7
0.3 - 0.4	0.352	6	49	0.122	13.0		
0.4 - 0.5	0.449	7	47	0.149	12.5	0.135	25.5
0.5 - 0.6	0.542	10	35	0.286	9.3		
0.6 - 0.7	0.647	16	45	0.356	12.0	0.325	21.3
0.7 - 0.8	0.740	9	36	0.250	9.6		
0.8 - 0.9	0.840	9	11	0.818	2.9	0.383	12.5
0.9 - 1.0	0.930	2	7	0.286	1.9		
1.0 - 3.0	1.089	8	8	1.000	2.1	0.667	4.0
-1.0 - 3.0	0.396	75	376	0.199		0.199	

Table B.42. Equation 46 Frequency Table for JJA 1979-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
-1.00 - -0.001	-0.077	1	64	0.016	17.0		
0.00 - 0.049	0.028	1	27	0.037	7.2	0.022	24.2
0.05 - 0.099	0.076	3	31	0.097	8.2		
0.10 - 0.199	0.143	5	66	0.076	17.6	0.082	25.8
0.20 - 0.299	0.252	15	62	0.242	16.5		
0.30 - 0.399	0.346	10	44	0.227	11.7	0.236	28.2
0.40 - 0.499	0.437	12	33	0.364	8.8		
0.50 - 0.599	0.549	10	23	0.435	6.1	0.393	14.9
0.60 - 0.699	0.634	6	13	0.462	3.5		
0.60 - 0.799	0.745	10	11	0.909	2.9	0.667	6.4
0.80 - 0.900	0.835	2	2	1.000	0.5		
-1.00 - 0.900	0.223	75	376	0.199	100.0	0.199	100.0

Table B.43. Equations 41 and 46 12Z Radiosonde Thunder Contingency Tables for June 15 to August 31.

CONTINGENCY TABLE

MONTH: JJA YEARS: 1970-83 LOCATION: KSLC

EQUATION: 41 TIME: 12Z

		OBSERVED YES	OBSERVED NO	TOTAL
F	YES	113	121	234
C S	NO	89	741	830
T	TOTAL	202	862	1064

D: 716.8 SS: 0.395 CORRECT: 80.3 %

EQUATION: 46 TIME: 12Z

		OBSERVED YES	OBSERVED NO	TOTAL
F	YES	127	120	247
C S	NO	75	742	817
T	TOTAL	202	862	1064

D: 708.8 SS: 0.451 CORRECT: 81.7 %

Table B.44. Equation 41 Frequency Table for JJA 1970-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.130	2	68	0.029	6.4		
0.0 - 0.1	0.057	0	88	0.000	8.3	0.013	14.7
0.1 - 0.2	0.149	2	117	0.017	11.0		
0.2 - 0.3	0.250	11	129	0.085	12.1	0.053	23.1
0.3 - 0.4	0.350	17	174	0.098	16.4		
0.4 - 0.5	0.446	25	138	0.181	13.0	0.135	29.3
0.5 - 0.6	0.544	32	116	0.276	10.9		
0.6 - 0.7	0.650	34	88	0.386	8.3	0.324	19.2
0.7 - 0.8	0.746	29	78	0.372	7.3		
0.8 - 0.9	0.838	20	29	0.690	2.7	0.458	10.1
0.9 - 1.0	0.938	15	23	0.652	2.2		
1.0 - 3.0	1.069	15	16	0.938	1.5	0.769	3.7
-1.0 - 3.0	0.385	202	1064	0.190		0.190	

Table B.45. Equation 46 Frequency Table for JJA 1970-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
-1.00 - -0.001	-0.067	1	195	0.005	18.3		
0.00 - 0.049	0.024	3	106	0.028	10.0	0.013	28.3
0.05 - 0.099	0.076	7	105	0.067	9.9		
0.10 - 0.149	0.121	5	102	0.049	9.6	0.058	19.5
0.15 - 0.199	0.174	10	92	0.109	8.6		
0.20 - 0.249	0.224	13	66	0.197	6.2	0.146	14.8
0.25 - 0.299	0.275	18	79	0.228	7.4		
0.30 - 0.349	0.324	18	71	0.254	6.7	0.240	14.1
0.35 - 0.399	0.370	24	62	0.387	5.8		
0.40 - 0.499	0.444	32	71	0.451	6.7	0.421	12.5
0.50 - 0.599	0.545	29	58	0.500	5.5		
0.60 - 0.699	0.636	22	35	0.629	3.3	0.548	8.7
0.70 - 0.799	0.744	13	14	0.929	1.3		
0.80 - 0.900	0.833	7	8	0.875	0.8	0.909	2.1
-1.00 - 0.900	0.198	202	1064	0.190		0.190	

Table B.46. Equations 36 and 47 00Z Radiosonde Thunder Dependent Data Contingency Tables for June 15 to August 31.

CONTINGENCY TABLE

MONTH: JJA   YEARS: 1970-78   LOCATION: KSLC

EQUATION: 36   TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	58	45	103
C				
	NO	56	534	590
S				
T	TOTAL	114	579	693

E: 509.9   SS: 0.448   CORRECT: 85.4 %

EQUATION: 47   TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	58	41	99
C				
	NO	56	538	594
S				
T	TOTAL	114	579	693

E: 512.6   SS: 0.462   CORRECT: 86.0 %

Table B.47. Equation 36 Frequency Table for JJA 1970-78.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.064	0	25	0.000	3.6		
0.0 - 0.1	0.061	0	48	0.000	6.9	0.000	10.5
0.1 - 0.2	0.152	2	89	0.022	12.8		
0.2 - 0.3	0.248	5	116	0.043	16.7	0.034	29.6
0.3 - 0.4	0.348	8	125	0.064	18.0		
0.4 - 0.5	0.450	22	104	0.212	15.0	0.131	33.0
0.5 - 0.6	0.545	19	83	0.229	12.0		
0.6 - 0.7	0.642	20	40	0.500	5.8	0.317	17.7
0.7 - 0.8	0.745	15	29	0.517	4.2		
0.8 - 0.9	0.854	10	18	0.556	2.6	0.532	6.8
0.9 - 1.0	0.949	6	7	0.857	1.0		
1.0 - 3.0	1.113	7	9	0.778	1.3	0.813	2.3
-1.0 - 3.0	0.373	114	693	0.165		0.165	

Table B.48. Equation 47 Frequency Table for JJA 1970-78.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.044	0	129	0.000	18.6		
0.0 - 0.1	0.050	7	186	0.038	26.8	0.022	45.5
0.1 - 0.2	0.149	16	149	0.107	21.5		
0.2 - 0.3	0.247	22	91	0.242	13.1	0.158	34.6
0.3 - 0.4	0.342	18	63	0.286	9.1		
0.4 - 0.5	0.437	19	27	0.704	3.9	0.411	13.0
0.5 - 0.6	0.537	8	17	0.471	2.5		
0.6 - 0.7	0.648	8	13	0.615	1.9	0.533	4.3
0.7 - 0.8	0.740	8	8	1.000	1.2		
0.8 - 0.9	0.832	6	6	1.000	0.9	1.000	2.0
0.9 - 1.0	0.961	1	2	0.500	0.3		
1.0 - 3.0	1.024	1	2	0.500	0.3	0.500	0.6
-1.0 - 3.0	0.165	114	693	0.165		0.165	

Table B.49. Equations 36 and 47 00Z Radiosonde Thunder Independent Data Contingency Tables for June 15 to August 31.

CONTINGENCY TABLE

MONTH: JJA   YEARS: 1979-81   LOCATION: KSLC

EQUATION: 36   TIME: 00Z

		OBSERVED YES	NO	TOTAL
F	YES	23	20	43
C S	NO	13	172	185
T	TOTAL	36	192	228

E: 162.6   SS: 0.496   CORRECT: 85.5 %

EQUATION: 47   TIME: 00Z

		OBSERVED YES	NO	TOTAL
F	YES	24	21	45
C S	NO	12	171	183
T	TOTAL	36	192	228

E: 161.2   SS: 0.506   CORRECT: 85.5 %

Table B.50. Equation 36 Frequency Table for JJA 1979-81.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.060	0	3	0.000	1.3		
0.0 - 0.1	0.051	0	9	0.000	3.9	0.000	5.3
0.1 - 0.2	0.161	0	25	0.000	11.0		
0.2 - 0.3	0.255	1	38	0.026	16.7	0.016	27.6
0.3 - 0.4	0.348	4	42	0.095	18.4		
0.4 - 0.5	0.440	3	37	0.081	16.2	0.089	34.6
0.5 - 0.6	0.552	5	31	0.161	13.6		
0.6 - 0.7	0.640	5	19	0.263	8.3	0.200	21.9
0.7 - 0.8	0.751	9	15	0.600	6.6		
0.8 - 0.9	0.853	3	3	1.000	1.3	0.667	7.9
0.9 - 1.0	0.966	4	4	1.000	1.8		
1.0 - 3.0	1.113	2	2	1.000	0.9	1.000	2.6
-1.0 - 3.0	0.413	36	228	0.158		0.158	

Table B.51. Equation 47 Frequency Table for JJA 1979-81.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.055	1	35	0.029	15.4		
0.0 - 0.1	0.053	1	52	0.019	22.8	0.023	38.2
0.1 - 0.2	0.144	5	50	0.100	21.9		
0.2 - 0.3	0.243	5	38	0.132	16.7	0.114	38.6
0.3 - 0.4	0.355	4	23	0.174	10.1		
0.4 - 0.5	0.460	6	13	0.462	5.7	0.278	15.8
0.5 - 0.6	0.546	3	5	0.600	2.2		
0.6 - 0.7	0.641	8	9	0.889	3.9	0.786	6.1
-1.0 - 0.7	0.188	36	228	0.158		0.158	

Table B.52. Equations 36 and 47 00Z Radiosonde Thunder Independent Data Contingency Tables for June 15 to August 31.

CONTINGENCY TABLE

MONTH: JJA YEARS: 1982-83 LOCATION: KSLC

EQUATION: 36 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	28	28	56
C S	NO	7	80	87
T	TOTAL	35	108	143

E: 79.4 SS: 0.450 CORRECT: 75.5 %

EQUATION: 47 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	28	29	57
C S	NO	7	79	86
T	TOTAL	35	108	143

E: 78.9 SS: 0.438 CORRECT: 74.8 %

Table B.53. Equation 36 Frequency Table for JJA 1982-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.152	0	7	0.000	4.9		
0.0 - 0.1	0.053	0	3	0.000	2.1	0.000	7.0
0.1 - 0.2	0.162	0	6	0.000	4.2		
0.2 - 0.3	0.245	0	13	0.000	9.1	0.000	13.3
0.3 - 0.4	0.349	1	18	0.056	12.6		
0.4 - 0.5	0.449	1	19	0.053	13.3	0.054	25.9
0.5 - 0.6	0.555	5	20	0.250	14.0		
0.6 - 0.7	0.646	4	14	0.286	9.8	0.265	23.8
0.7 - 0.8	0.745	15	22	0.682	15.4		
0.8 - 0.9	0.840	6	16	0.375	11.2	0.553	26.6
0.9 - 1.0	0.945	1	2	0.500	1.4		
1.0 - 3.0	1.038	2	3	0.667	2.1	0.600	3.5
-1.0 - 3.0	0.511	35	143	0.245		0.245	

Table B.54. Equation 47 Frequency Table for JJA 1982-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.063	0	11	0.000	7.7		
0.0 - 0.1	0.038	0	10	0.000	7.0	0.000	14.7
0.1 - 0.2	0.149	1	24	0.042	16.8		
0.2 - 0.3	0.247	5	28	0.179	19.6	0.115	36.4
0.3 - 0.4	0.349	4	26	0.154	18.2		
0.4 - 0.5	0.452	14	26	0.538	18.2	0.346	36.4
0.5 - 0.6	0.539	3	7	0.429	4.9		
0.6 - 0.7	0.668	4	6	0.667	4.2	0.538	9.1
0.7 - 0.8	0.724	2	3	0.667	2.1	0.667	2.1
-1.0 - 3.0	0.300	35	143	0.245		0.245	

Table C.7. MJS 12Z RH4 CBPRE 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.0 - 24.9	22.00	7	79	0.089	12.1
25.0 - 29.9	27.53	19	94	0.202	14.4
30.0 - 34.9	32.07	12	67	0.179	10.3
35.0 - 39.9	37.14	20	77	0.260	11.8
40.0 - 44.9	42.89	24	43	0.558	6.6
45.0 - 49.9	47.41	38	73	0.521	11.2
50.0 - 54.9	52.54	35	54	0.648	8.3
55.0 - 59.9	57.63	25	35	0.714	5.4
60.0 - 69.9	64.14	53	62	0.855	9.5
70.0 - 79.9	74.62	35	37	0.946	5.7
80.0 - 100.0	87.20	29	30	0.967	4.6
0.0 - 100.0	44.31	297	651	0.456	100.0

Table C.6. MJS 12Z PW CBPRE 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.05 - 0.14	0.12	0	2	0.000	0.6
0.15 - 0.24	0.21	3	14	0.214	3.9
0.25 - 0.29	0.28	8	20	0.400	5.5
0.30 - 0.34	0.32	15	44	0.341	12.2
0.35 - 0.39	0.37	8	37	0.216	10.2
0.40 - 0.44	0.42	14	35	0.400	9.7
0.45 - 0.54	0.49	30	69	0.435	19.1
0.55 - 0.64	0.60	37	50	0.740	13.9
0.65 - 0.74	0.68	31	41	0.756	11.4
0.75 - 0.99	0.84	35	41	0.854	11.4
1.00 - 2.00	1.14	8	8	1.000	2.2
0.05 - 2.00	0.52	189	361	0.524	

Table C.5. MJS 12Z PW CBPRE 1970-1978 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.05 - 0.14	0.12	0	2	0.000	0.3
0.15 - 0.24	0.21	7	50	0.140	7.7
0.25 - 0.29	0.27	9	65	0.138	10.0
0.30 - 0.34	0.32	30	95	0.316	14.6
0.35 - 0.39	0.37	25	75	0.333	11.5
0.40 - 0.44	0.42	37	74	0.500	11.4
0.45 - 0.54	0.49	66	127	0.520	19.5
0.55 - 0.64	0.59	44	67	0.657	10.3
0.65 - 0.74	0.69	34	46	0.739	7.1
0.75 - 0.99	0.82	35	40	0.875	6.1
1.00 - 2.00	1.10	10	10	1.000	1.5
0.05 - 2.00	0.45	297	651	0.456	

Table C.4. MJS 12Z LINWS CBPRE 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.00 - -0.01	-1.18	10	12	0.833	3.3
0.00 - 1.24	0.67	31	33	0.939	9.1
1.25 - 2.49	1.92	36	43	0.837	11.9
2.50 - 2.99	2.66	19	23	0.826	6.4
3.00 - 3.99	3.43	18	28	0.643	7.8
4.00 - 4.99	4.47	24	37	0.649	10.2
5.00 - 5.99	5.57	10	22	0.455	6.1
6.00 - 6.99	6.30	10	26	0.385	7.2
7.00 - 7.99	7.38	9	28	0.321	7.8
8.00 - 9.99	8.90	13	43	0.302	11.9
10.00 - 25.00	12.65	9	66	0.136	18.3
-10.00 - 25.00	5.89	189	361	0.524	

Table C.3. MJS 12Z LINWS 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.00 - -0.01	-0.50	2	2	1.000	0.3
0.00 - 1.24	0.71	28	34	0.824	5.2
1.25 - 2.49	1.84	40	44	0.909	6.8
2.50 - 2.99	2.70	34	41	0.829	6.3
3.00 - 3.99	3.42	51	69	0.739	10.6
4.00 - 4.99	4.47	42	65	0.646	10.0
5.00 - 5.99	5.46	32	59	0.542	9.1
6.00 - 6.99	6.46	28	59	0.475	9.1
7.00 - 7.99	7.43	9	38	0.237	5.8
8.00 - 9.99	8.92	21	92	0.228	14.1
10.00 - 25.00	12.90	10	148	0.068	22.7
-10.00 - 25.00	6.84	297	651	0.456	

Table C.2. MJS 12Z K Index CBPRE 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-25.0 - -0.1	-5.00	0	12	0.000	3.3
0.0 - 4.9	2.63	1	14	0.071	3.9
5.0 - 9.9	7.87	6	34	0.176	9.4
10.0 - 14.9	12.57	14	58	0.241	16.1
15.0 - 17.4	16.11	8	28	0.286	7.8
17.5 - 19.9	18.61	8	21	0.381	5.8
20.0 - 22.4	21.29	20	30	0.667	8.3
22.5 - 24.9	23.85	19	29	0.655	8.0
25.0 - 27.4	26.24	21	29	0.724	8.0
27.5 - 29.9	28.73	30	35	0.857	9.7
30.0 - 55.0	32.90	62	71	0.873	19.7
-25.0 - 55.0	20.08	189	361	0.524	

Table C.1. MJS 12Z K Index CBPRE 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-25.0 - -0.1	-4.14	2	28	0.071	4.3
0.0 - 4.9	2.76	4	62	0.065	9.5
5.0 - 9.9	7.72	18	82	0.220	12.6
10.0 - 14.9	12.43	33	112	0.295	17.2
15.0 - 17.4	16.13	21	65	0.323	10.0
17.5 - 19.9	18.52	28	50	0.560	7.7
20.0 - 22.4	21.12	30	48	0.625	7.4
22.5 - 24.9	23.61	34	52	0.654	8.0
25.0 - 27.4	26.33	33	48	0.688	7.4
27.5 - 29.9	28.76	47	53	0.887	8.1
30.0 - 55.0	32.10	47	51	0.922	7.8
-25.0 - 55.0	16.47	297	651	0.456	

APPENDIX C

PREDICTOR PROBABILITY TABLES

Table B.60. Equation 47 Frequency Table for JJA 1970-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
-1.00 - -0.001	-0.047	1	175	0.006	16.4		
0.00 - 0.049	0.026	3	129	0.023	12.1	0.013	28.6
0.05 - 0.099	0.076	5	119	0.042	11.2		
0.10 - 0.149	0.125	9	119	0.076	11.2	0.059	22.4
0.15 - 0.199	0.174	13	104	0.125	9.8		
0.20 - 0.249	0.225	16	90	0.178	8.5	0.149	18.2
0.25 - 0.299	0.275	16	67	0.239	6.3		
0.30 - 0.349	0.322	12	60	0.200	5.6	0.220	11.9
0.35 - 0.399	0.374	14	52	0.269	4.9		
0.40 - 0.499	0.447	39	66	0.591	6.2	0.449	11.1
0.50 - 0.599	0.539	14	29	0.483	2.7		
0.60 - 0.699	0.650	20	28	0.714	2.6	0.596	5.4
0.70 - 3.000	0.844	23	26	0.885	2.4	0.885	2.4
-1.00 - 3.000	0.188	185	1064	0.174		0.174	

Table B.59. Equation 36 Frequency Table for JJA 1970-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.081	0	35	0.000	3.3		
0.0 - 0.1	0.059	0	60	0.000	5.6	0.000	8.9
0.1 - 0.2	0.154	2	120	0.017	11.3		
0.2 - 0.3	0.250	6	167	0.036	15.7	0.028	27.0
0.3 - 0.4	0.348	13	185	0.070	17.4		
0.4 - 0.5	0.447	26	160	0.162	15.0	0.113	32.4
0.5 - 0.6	0.548	29	134	0.216	12.6		
0.6 - 0.7	0.642	29	73	0.397	6.9	0.280	19.5
0.7 - 0.8	0.746	39	66	0.591	6.2		
0.8 - 0.9	0.848	19	37	0.514	3.5	0.563	9.7
0.9 - 1.0	0.954	11	13	0.846	1.2		
1.0 - 3.0	1.097	11	14	0.786	1.3	0.815	2.5
-1.0 - 3.0	0.400	185	1064	0.174		0.174	

Table B.58. Equations 36 and 47 00Z Radiosonde Thunder Contingency Tables for June 15 to August 31.

CONTINGENCY TABLE

MONTH: JJA YEARS: 1970-83 LOCATION: KSLC

EQUATION: 36 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	109	93	202
C				
	NO	76	786	862
S				
T	TOTAL	185	879	1064

E: 747.2 SS: 0.466 CORRECT: 84.1 %

EQUATION: 47 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	110	91	201
C				
	NO	75	788	863
S				
T	TOTAL	185	879	1064

E: 747.9 SS: 0.475 CORRECT: 84.4 %

Table B.57. Equation 47 Frequency Table for JJA 1979-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.057	1	46	0.022	12.4		
0.0 - 0.1	0.050	1	62	0.016	16.7	0.019	29.1
0.1 - 0.2	0.146	6	74	0.081	19.9		
0.2 - 0.3	0.245	10	66	0.152	17.8	0.114	37.7
0.3 - 0.4	0.352	8	49	0.163	13.2		
0.4 - 0.5	0.455	20	39	0.513	10.5	0.318	23.7
0.5 - 0.6	0.542	6	12	0.500	3.2		
0.6 - 0.7	0.652	12	15	0.800	4.0	0.667	7.3
0.7 - 0.8	0.724	2	3	0.667	0.8		
0.8 - 0.9	0.846	1	1	1.000	0.3	0.750	1.1
0.9 - 1.0	0.935	1	1	1.000	0.3		
1.0 - 3.0	1.034	3	3	1.000	0.8	1.000	1.1
-1.0 - 3.0	0.231	71	371	0.191		0.191	

Table B.56. Equation 36 Frequency Table for JJA 1979-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT	TWO TENTHS R CLASS FREQ	TWO TENTHS R CLASS PRCNT
(-1.0)-(-0.0)	-0.124	0	10	0.000	2.7		
0.0 - 0.1	0.051	0	12	0.000	3.2	0.000	5.9
0.1 - 0.2	0.161	0	31	0.000	8.4		
0.2 - 0.3	0.253	1	51	0.020	13.7	0.012	22.1
0.3 - 0.4	0.348	5	60	0.083	16.2		
0.4 - 0.5	0.443	4	56	0.071	15.1	0.078	31.3
0.5 - 0.6	0.553	10	51	0.196	13.7		
0.6 - 0.7	0.643	9	33	0.273	8.9	0.226	22.6
0.7 - 0.8	0.747	24	37	0.649	10.0		
0.8 - 0.9	0.842	9	19	0.474	5.1	0.589	15.1
0.9 - 1.0	0.959	5	6	0.833	1.6		
1.0 - 3.0	1.068	4	5	0.800	1.3	0.818	3.0
-1.0 - 3.0	0.450	71	371	0.191		0.191	

Table B.55. Equations 36 and 47 00Z Radiosonde Thunder Independent Data Contingency Tables for June 15 to August 31.

CONTINGENCY TABLE

MONTH: JJA YEARS: 1979-83 LOCATION: KSLC

EQUATION: 36 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	51	48	99
C S	NO	20	252	272
T	TOTAL	71	300	371

E: 238.9 SS: 0.485 CORRECT: 81.7 %

EQUATION: 47 TIME: 00Z

		OBSERVED		
		YES	NO	TOTAL
F	YES	52	50	102
C S	NO	19	250	269
T	TOTAL	71	300	371

E: 237.0 SS: 0.485 CORRECT: 81.4 %

Table C.8. MJS 12Z RH4 CBPRE 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.0 - 24.9	20.87	7	43	0.163	11.9
25.0 - 29.9	27.50	3	36	0.083	10.0
30.0 - 34.9	32.13	4	27	0.148	7.5
3=.0 - 39.9	37.30	11	36	0.306	10.0
40.0 - 44.9	42.60	15	29	0.517	8.0
45.0 - 49.9	47.70	16	30	0.533	8.3
50.0 - 54.9	51.95	12	22	0.545	6.1
55.0 - 59.9	57.61	24	32	0.750	8.9
60.0 - 69.9	65.00	41	46	0.891	12.7
70.0 - 79.9	74.93	28	32	0.875	8.9
80.0 - 100.0	85.13	28	28	1.000	7.8
0.0 - 100.0	48.60	189	361	0.524	

Table C.9. MJS 12Z TOT CBPRE 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.0 - 14.9	10.14	3	51	0.059	7.8
15.0 - 19.9	17.55	9	93	0.097	14.3
20.0 - 22.4	21.17	11	61	0.180	9.4
22.5 - 24.9	23.70	29	81	0.358	12.4
25.0 - 25.9	25.37	9	34	0.265	5.2
26.0 - 26.9	26.48	18	33	0.545	5.1
27.0 - 27.9	27.44	20	41	0.488	6.3
28.0 - 29.9	28.96	54	90	0.600	13.8
30.0 - 32.4	31.20	77	93	0.828	14.3
32.5 - 34.9	33.49	49	54	0.907	8.3
35.0 - 55.0	36.29	18	20	0.900	3.1
-10.0 - 55.0	24.98	297	651	0.456	

Table C.10. MJS 12Z TOT CBPRE 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.0 - 14.9	10.47	2	32	0.063	8.9
15.0 - 19.9	18.15	6	35	0.171	9.7
20.0 - 22.4	21.43	9	25	0.360	6.9
22.5 - 24.9	23.61	9	41	0.220	11.4
25.0 - 25.9	25.41	5	13	0.385	3.6
26.0 - 26.9	26.52	8	16	0.500	4.4
27.0 - 27.9	27.40	14	27	0.519	7.5
28.0 - 29.9	29.08	30	47	0.638	13.0
30.0 - 32.4	31.32	47	57	0.825	15.8
32.5 - 34.9	33.41	46	53	0.868	14.7
35.0 - 55.0	36.80	13	15	0.867	4.2
-10.0 - 55.0	26.16	189	361	0.524	

Table C.11. MJS 00Z K Index CBPRE 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	PRCNT
-15.0 - -0.1	-4.28	0	19	0.000	2.8
0.0 - 4.9	2.47	0	27	0.000	4.0
5.0 - 9.9	7.65	2	63	0.032	9.4
10.0 - 14.9	12.53	20	104	0.192	15.5
15.0 - 17.4	16.32	23	69	0.333	10.3
17.5 - 19.9	18.62	35	86	0.407	12.8
20.0 - 22.4	21.24	37	78	0.474	11.6
22.5 - 24.9	23.55	41	71	0.577	10.6
25.0 - 27.4	26.17	58	67	0.866	10.0
27.5 - 29.9	28.68	32	39	0.821	5.8
30.0 - 40.0	32.42	44	49	0.898	7.3
-15.0 - 40.0	18.28	292	672	0.435	

Table C.12. MJS 00Z K Index 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-25.0 - -0.1	-12.48	0	8	0.000	2.2
0.0 - 4.9	2.56	0	14	0.000	3.9
5.0 - 9.9	7.88	0	15	0.000	4.2
10.0 - 14.9	13.10	5	35	0.143	9.8
15.0 - 17.4	16.50	5	24	0.208	6.7
17.5 - 19.9	18.61	7	28	0.250	7.8
20.0 - 22.4	21.25	13	43	0.302	12.0
22.5 - 24.9	23.68	16	39	0.410	10.9
25.0 - 27.4	26.26	32	46	0.696	12.8
27.5 - 29.9	28.53	31	39	0.795	10.9
30.0 - 45.0	33.13	57	67	0.851	18.7
-25.0 - 45.0	21.81	166	358	0.464	

Table C.13. MJS 00Z LINWS CBPRE 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.0 - -2.01	-2.77	14	19	0.737	2.8
-2.0 - -1.01	-1.50	19	26	0.731	3.9
-1.0 - -0.01	-0.49	42	59	0.712	8.8
0.0 - 0.49	0.22	28	43	0.651	6.4
0.5 - 0.99	0.70	27	48	0.563	7.1
1.0 - 1.49	1.20	35	45	0.778	6.7
1.5 - 1.99	1.70	25	42	0.595	6.3
2.0 - 2.49	2.16	34	55	0.618	8.2
2.5 - 2.99	2.71	17	45	0.378	6.7
3.0 - 3.99	3.42	25	84	0.298	12.5
4.0 - 25.00	6.92	26	206	0.126	30.7
-10.0 - 25.00	2.98	292	672	0.435	100.0

Table C.14. MJS 00Z LINWS CBPRE 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.0 - -2.01	-3.24	17	26	0.654	7.3
-2.0 - -1.01	-1.60	22	31	0.710	8.7
-1.0 - -0.01	-0.58	37	50	0.740	14.0
0.0 - 0.49	0.25	21	34	0.618	9.5
0.5 - 0.99	0.67	22	31	0.710	8.7
1.0 - 1.49	1.21	12	25	0.480	7.0
1.5 - 1.99	1.70	7	19	0.368	5.3
2.0 - 2.49	2.20	7	18	0.389	5.0
2.5 - 2.99	2.67	7	22	0.318	6.1
3.0 - 3.99	3.43	8	32	0.250	8.9
4.0 - 25.00	6.86	6	70	0.086	19.6
-10.0 - 25.00	1.72	166	358	0.464	100.0

Table C.15. MJS 00Z PW CBPRE 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	PRCNT
0.05 - 0.14	0.12	0	7	0.000	1.0
0.15 - 0.24	0.21	11	60	0.183	8.9
0.25 - 0.29	0.27	11	74	0.149	11.0
0.30 - 0.34	0.32	28	88	0.318	13.1
0.35 - 0.39	0.37	40	98	0.408	14.6
0.40 - 0.44	0.42	27	78	0.346	11.6
0.45 - 0.54	0.49	60	116	0.517	17.3
0.55 - 0.64	0.59	52	77	0.675	11.5
0.65 - 0.74	0.70	19	26	0.731	3.9
0.75 - 0.99	0.84	37	40	0.925	6.0
1.00 - 1.20	1.10	7	8	0.875	1.2
0.05 - 1.20	0.44	292	672	0.435	

Table C.16. MJS 00Z PW CBPRE 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.05 - 0.14	0.11	0	3	0.000	0.8
0.15 - 0.24	0.21	2	16	0.125	4.5
0.25 - 0.29	0.27	4	12	0.333	3.4
0.30 - 0.34	0.32	9	34	0.265	9.5
0.35 - 0.39	0.37	11	38	0.289	10.6
0.40 - 0.44	0.42	15	45	0.333	12.6
0.45 - 0.54	0.50	31	77	0.403	21.5
0.55 - 0.64	0.59	30	54	0.556	15.1
0.65 - 0.74	0.69	28	38	0.737	10.6
0.75 - 0.99	0.83	28	32	0.875	8.9
1.00 - 1.20	1.07	8	9	0.889	2.5
0.05 - 1.20	0.51	166	358	0.464	

Table C.17. MJS 00Z RH4 CBPRE 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.0 - 19.9	17.96	0	37	0.000	5.5
20.0 - 24.9	22.42	6	112	0.054	16.7
25.0 - 29.9	27.24	10	110	0.091	16.4
30.0 - 34.9	32.38	30	90	0.333	13.4
35.0 - 39.9	37.34	45	85	0.529	12.6
40.0 - 44.9	42.42	37	56	0.661	8.3
45.0 - 54.9	50.01	56	65	0.862	9.7
55.0 - 59.9	57.35	17	23	0.739	3.4
60.0 - 69.9	64.02	46	49	0.939	7.3
70.0 - 79.9	75.09	20	20	1.000	3.0
80.0 - 100.0	84.19	25	25	1.000	3.7
0.0 - 100.0	38.6	292	672	0.435	

Table C.18. MJS 00Z RH4 CBPRE 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.0 - 19.9	15.25	0	15	0.000	4.2
20.0 - 24.9	22.85	1	47	0.021	13.1
25.0 - 29.9	27.69	5	43	0.116	12.0
30.0 - 34.9	32.44	14	47	0.298	13.1
35.0 - 39.9	37.03	12	35	0.343	9.8
40.0 - 44.9	42.46	12	27	0.444	7.5
45.0 - 49.9	47.33	17	26	0.654	7.3
50.0 - 59.9	54.77	42	50	0.840	14.0
60.0 - 69.9	63.33	24	27	0.889	7.5
70.0 - 79.9	75.12	27	29	0.931	8.1
80.0 - 100.0	84.87	12	12	1.000	3.4
0.0 - 100.0	42.8	166	358	0.464	

Table C.19. MJS 00Z SURDEP CBPRE 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.0 - 3.9	2.74	17	17	1.000	2.5
4.0 - 7.9	5.90	27	27	1.000	4.0
8.0 - 11.9	10.23	43	47	0.915	7.0
12.0 - 15.9	14.28	34	50	0.680	7.4
16.0 - 17.9	17.03	25	50	0.500	7.4
18.0 - 19.9	18.94	24	55	0.436	8.2
20.0 - 21.9	21.04	32	80	0.400	11.9
22.0 - 23.9	22.95	28	77	0.364	11.5
24.0 - 27.9	25.66	36	114	0.316	17.0
28.0 - 31.9	30.03	20	109	0.183	16.2
32.0 - 50.0	36.32	6	46	0.130	6.8
0.0 - 50.0	21.75	292	672	0.435	

Table C.20. MJS 00Z MJS SURDEP 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.0 - 3.9	2.84	21	21	1.000	5.9
4.0 - 7.9	5.83	17	18	0.944	5.0
8.0 - 11.9	10.07	27	35	0.771	9.8
12.0 - 15.9	13.99	34	44	0.773	12.3
16.0 - 17.9	16.77	16	33	0.485	9.2
18.0 - 19.9	18.97	15	38	0.395	10.6
20.0 - 21.9	20.79	7	26	0.269	7.3
22.0 - 23.9	22.76	7	29	0.241	8.1
24.0 - 27.9	25.74	12	61	0.197	17.0
28.0 - 31.9	29.58	8	35	0.229	9.8
32.0 - 50.0	35.58	2	18	0.111	5.0
0.0 - 50.0	19.14	166	358	0.464	100.0

Table C.21. MJS 00Z TOT CBPRE 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.0 - 14.9	10.15	0	59	0.000	8.8
15.0 - 19.9	17.86	7	85	0.082	12.6
20.0 - 22.4	21.41	7	73	0.096	10.9
22.5 - 24.9	23.74	19	77	0.247	11.5
25.0 - 25.9	25.52	9	31	0.290	4.6
26.0 - 26.9	26.53	21	44	0.477	6.5
27.0 - 27.9	27.44	34	54	0.630	8.0
28.0 - 29.9	28.89	71	107	0.664	15.9
30.0 - 32.4	31.04	77	89	0.865	13.2
32.5 - 34.9	33.50	35	40	0.875	6.0
35.0 - 55.0	38.12	12	13	0.923	1.9
-10.0 - 55.0	24.76	292	672	0.435	

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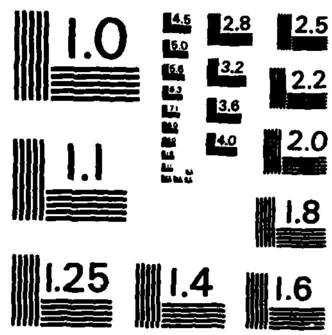

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Table C.22. MJS 00Z TOT CBPRE 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.0 - 14.9	9.13	0	25	0.000	7.0
15.0 - 19.9	17.86	5	34	0.147	9.5
20.0 - 22.4	21.20	2	27	0.074	7.5
22.5 - 24.9	23.67	6	35	0.171	9.8
25.0 - 25.9	25.44	11	26	0.423	7.3
26.0 - 26.9	26.55	8	16	0.500	4.5
27.0 - 27.9	27.37	9	23	0.391	6.4
28.0 - 29.9	29.13	38	55	0.691	15.4
30.0 - 32.4	31.07	52	73	0.712	20.4
32.5 - 34.9	33.54	30	39	0.769	10.9
35.0 - 55.0	35.86	5	5	1.000	1.4
-10.0 - 55.0	26.00	166	358	0.464	

Table C.23. JJA 12Z K Index CBPRE 1970-78 Frequency Table.

				ONE TENTH R CLASS	
ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	FREQ	PRCNT
-25.0 - -0.1	-1.83	0	10	0.000	1.5
0.0 - 4.9	2.58	1	12	0.083	1.7
5.0 - 9.9	7.60	8	78	0.103	11.3
10.0 - 14.9	12.42	26	134	0.194	19.5
15.0 - 17.4	16.15	29	73	0.397	10.6
17.5 - 19.9	18.57	24	71	0.338	10.3
20.0 - 22.4	21.28	29	58	0.500	8.4
22.5 - 24.9	23.77	41	79	0.519	11.5
25.0 - 27.4	26.34	30	46	0.652	6.7
27.5 - 29.9	28.54	38	51	0.745	7.4
30.0 - 55.0	33.04	68	76	0.895	11.0
-25.0 - 55.0	18.98	294	688	0.427	

Table C.24. JJA 12Z K Index CBPRE 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-25.0 - -0.1	-2.65	0	6	0.000	1.6
0.0 - 4.9	2.86	3	17	0.176	4.5
5.0 - 9.9	8.14	5	38	0.132	10.1
10.0 - 14.9	12.82	14	50	0.280	13.3
15.0 - 17.4	15.97	13	39	0.333	10.4
17.5 - 19.9	18.54	10	23	0.435	6.1
20.0 - 22.4	21.38	13	28	0.464	7.4
22.5 - 24.9	23.72	30	41	0.732	10.9
25.0 - 27.4	26.13	20	38	0.526	10.1
27.5 - 29.9	28.80	15	26	0.577	6.9
30.0 - 55.0	34.34	60	70	0.857	18.6
-25.0 - 55.0	20.61	183	376	0.487	

Table C.25. JJA 12Z LINWS CBPRE 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-3.0 - -0.01	-0.68	30	33	0.909	4.8
0.0 - 0.99	0.52	29	37	0.784	5.4
1.0 - 1.99	1.48	57	77	0.740	11.2
2.0 - 2.49	2.20	22	45	0.489	6.5
2.5 - 2.99	2.68	28	41	0.683	6.0
3.0 - 3.99	3.46	49	86	0.570	12.5
4.0 - 4.99	4.50	36	81	0.444	11.8
5.0 - 5.99	5.42	20	66	0.303	9.6
6.0 - 7.99	6.90	17	95	0.179	13.8
8.0 - 9.99	8.90	5	62	0.081	9.0
10.0 - 30.00	11.83	1	65	0.015	9.4
-3.0 - 30.00	4.82	294	688	0.427	

Table C.26. JJA 12Z LINWS CBPRE 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-30.0 - -0.01	-1.20	18	23	0.783	6.1
0.0 - 0.99	0.44	17	20	0.850	5.3
1.0 - 1.99	1.49	17	23	0.739	6.1
2.0 - 2.49	2.16	1	5	0.200	1.3
2.5 - 2.99	2.66	2	5	0.400	1.3
3.0 - 3.99	3.51	7	12	0.583	3.2
4.0 - 4.99	4.52	8	15	0.533	4.0
5.0 - 5.99	5.34	7	14	0.500	3.7
6.0 - 7.99	7.07	29	53	0.547	14.1
8.0 - 9.99	8.98	36	79	0.456	21.0
10.0 - 30.00	12.52	41	127	0.323	33.8
-3.0 - 30.00	7.71	183	376	0.487	

Table C.27. JJA 12Z PW CBPRE 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.15 - 0.29	0.26	1	26	0.038	3.8
0.30 - 0.39	0.36	9	97	0.093	14.1
0.40 - 0.44	0.42	15	69	0.217	10.0
0.45 - 0.49	0.47	17	76	0.224	11.0
0.50 - 0.54	0.52	24	70	0.343	10.2
0.55 - 0.59	0.57	29	61	0.475	8.9
0.60 - 0.64	0.62	32	59	0.542	8.6
0.65 - 0.74	0.69	40	79	0.506	11.5
0.75 - 0.84	0.80	41	54	0.759	7.8
0.85 - 0.99	0.91	42	51	0.824	7.4
1.00 - 2.00	1.13	44	46	0.957	6.7
0.15 - 2.00	0.60	294	688	0.427	

Table C.28. JJA 12Z PW CBPRE 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.15 - 0.29	0.27	0	9	0.000	2.4
0.30 - 0.39	0.35	6	34	0.176	9.0
0.40 - 0.44	0.42	5	37	0.135	9.8
0.45 - 0.49	0.47	11	39	0.282	10.4
0.50 - 0.54	0.52	6	22	0.273	5.9
0.55 - 0.59	0.57	18	40	0.450	10.6
0.60 - 0.64	0.62	13	28	0.464	7.4
0.65 - 0.74	0.69	34	61	0.557	16.2
0.75 - 0.84	0.80	30	36	0.833	9.6
0.85 - 0.99	0.91	24	29	0.828	7.7
1.00 - 2.00	1.14	36	41	0.878	10.9
0.15 - 2.00	0.65	183	376	0.487	

Table C.29. JJA 12Z RH4 CBPRE 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.0 - 24.9	21.53	9	122	0.074	17.7
25.0 - 29.9	27.69	19	97	0.196	14.1
30.0 - 34.9	32.65	17	88	0.193	12.8
35.0 - 39.9	37.42	32	76	0.421	11.0
40.0 - 44.9	42.65	31	76	0.408	11.0
45.0 - 49.9	47.48	46	64	0.719	9.3
50.0 - 54.9	52.32	39	53	0.736	7.7
55.0 - 59.9	56.96	32	38	0.842	5.5
60.0 - 69.9	64.76	39	44	0.886	6.4
70.0 - 79.9	74.55	21	21	1.000	3.1
80.0 - 100.0	86.53	9	9	1.000	1.3
0.0 - 100.0	39.88	294	688	0.427	

Table C.30. JJA 12Z RH4 CBPRE 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.0 - 24.9	21.14	5	55	0.091	14.6
25.0 - 29.9	27.58	10	41	0.244	10.9
30.0 - 34.9	32.37	10	37	0.270	9.8
35.0 - 39.9	37.39	19	47	0.404	12.5
40.0 - 44.9	42.61	28	50	0.560	13.3
45.0 - 49.9	47.38	23	39	0.590	10.4
50.0 - 54.9	52.33	26	35	0.743	9.3
55.0 - 59.9	56.87	14	18	0.778	4.8
60.0 - 69.9	64.92	25	29	0.862	7.7
70.0 - 79.9	75.14	18	20	0.900	5.3
80.0 - 100.0	84.78	5	5	1.000	1.3
0.0 - 100.0	42.26	183	376	0.487	

Table C.31. JJA 12Z TOT CBPRE 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.0 - 14.9	12.35	0	22	0.000	3.2
15.0 - 19.9	17.80	4	72	0.056	10.5
20.0 - 22.4	21.27	14	70	0.200	10.2
22.5 - 24.9	23.91	21	82	0.256	11.9
25.0 - 25.9	25.36	17	48	0.354	7.0
26.0 - 26.9	26.52	22	50	0.440	7.3
27.0 - 27.9	27.43	41	70	0.586	10.2
28.0 - 29.9	28.82	82	135	0.607	19.6
30.0 - 32.4	31.19	67	106	0.632	15.4
32.5 - 34.9	33.37	22	29	0.759	4.2
35.0 - 55.0	36.00	4	4	1.000	0.6
-10.0 - 55.0	25.83	294	688	0.427	

Table C.32. JJA 12Z TOT CBPRE 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.0 - 14.9	10.10	1	16	0.063	4.3
15.0 - 19.9	17.75	4	37	0.108	9.8
20.0 - 22.4	21.33	5	33	0.152	8.8
22.5 - 24.9	23.80	16	50	0.320	13.3
25.0 - 25.9	25.49	5	10	0.500	2.7
26.0 - 26.9	26.53	16	31	0.516	8.2
27.0 - 27.9	27.46	16	29	0.552	7.7
28.0 - 29.9	28.90	42	67	0.627	17.8
30.0 - 32.4	31.04	56	75	0.747	19.9
32.5 - 34.9	33.82	19	23	0.826	6.1
35.0 - 55.0	36.18	3	5	0.600	1.3
-10.0 - 55.0	26.09	183	376	0.487	

Table C.33. JJA 00Z K Index CBPRE 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-25.0 - 4.9	1.66	0	9	0.000	1.3
5.0 - 9.9	8.14	0	20	0.000	2.9
10.0 - 14.9	13.14	4	74	0.054	10.7
15.0 - 17.4	16.26	6	60	0.100	8.7
17.5 - 19.9	18.75	20	98	0.204	14.1
20.0 - 22.4	21.23	31	107	0.290	15.4
22.5 - 24.9	23.63	61	112	0.545	16.2
25.0 - 27.4	26.25	48	82	0.585	11.8
27.5 - 29.9	28.54	42	53	0.792	7.6
30.0 - 39.9	33.08	71	77	0.922	11.1
40.0 - 55.0	40.90	1	1	1.000	0.1
-25.0 - 55.0	21.84	284	693	0.410	100.0

Table C.47. MJS 12Z LINWS TSTM 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.00 - -0.1	-0.50	1	2	0.500	0.3
0.00 - 1.24	0.71	10	34	0.294	5.2
1.25 - 2.49	1.84	19	44	0.432	6.8
2.50 - 2.99	2.70	15	41	0.366	6.3
3.00 - 3.99	3.42	20	69	0.290	10.6
4.00 - 4.99	4.47	14	65	0.215	10.0
5.00 - 5.99	5.46	9	59	0.153	9.1
6.00 - 6.99	6.46	7	59	0.119	9.1
7.00 - 7.99	7.43	1	38	0.026	5.8
8.00 - 9.99	8.92	3	92	0.033	14.1
10.00 - 14.99	12.02	2	122	0.016	18.7
15.00 - 25.00	17.02	0	26	0.000	4.0
-10.00 - 25.00	6.85	101	651	0.155	

Table C.46. MJS 12Z K Index TSTM 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-25.0 - -0.1	-5.00	0	12	0.000	3.3
0.0 - 4.9	2.63	0	14	0.000	3.9
5.0 - 9.9	7.87	1	34	0.029	9.4
10.0 - 12.4	11.42	1	29	0.034	8.0
12.5 - 14.9	13.72	4	29	0.138	8.0
15.0 - 17.4	16.11	2	28	0.071	7.8
17.5 - 19.9	18.61	2	21	0.095	5.8
20.0 - 22.4	21.29	10	30	0.333	8.3
22.5 - 24.9	23.85	3	29	0.103	8.0
25.0 - 27.4	26.24	6	29	0.207	8.0
27.5 - 29.9	28.73	11	35	0.314	9.7
30.0 - 32.4	31.06	10	35	0.286	9.7
32.5 - 55.0	34.68	12	36	0.333	10.0
-25.0 - 55.0	20.08	62	361	0.172	100.0

Table C.45. MJS 12Z K Index TSTM 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-25.0 - -0.1	-4.14	1	28	0.036	4.3
0.0 - 4.9	2.76	0	62	0.000	9.5
5.0 - 9.9	7.72	1	82	0.012	12.6
10.0 - 12.4	11.15	4	57	0.070	8.8
12.5 - 14.9	13.74	3	55	0.055	8.4
15.0 - 17.4	16.13	4	65	0.062	10.0
17.5 - 19.9	18.52	7	50	0.140	7.7
20.0 - 22.4	21.12	9	48	0.188	7.4
22.5 - 24.9	23.61	15	52	0.288	8.0
25.0 - 27.4	26.33	14	48	0.292	7.4
27.5 - 29.9	28.76	19	53	0.358	8.1
30.0 - 32.4	31.03	13	32	0.406	4.9
32.5 - 55.0	33.89	11	19	0.579	2.9
-25.0 - 55.0	16.47	101	651	0.155	

Table C.44. JJA OOZ TOT CBPRE 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	PRCNT
-20.0 - 14.9	9.01	1	16	0.063	4.3
15.0 - 19.9	17.74	1	30	0.033	8.1
20.0 - 22.4	21.41	4	33	0.121	8.9
22.5 - 24.9	23.60	2	41	0.049	11.1
25.0 - 25.9	25.48	3	19	0.158	5.1
26.0 - 26.9	26.52	11	25	0.440	6.7
27.0 - 27.9	27.49	17	35	0.486	9.4
28.0 - 28.9	28.51	25	39	0.641	10.5
29.0 - 29.9	29.48	23	31	0.742	8.4
30.0 - 32.4	30.98	53	67	0.791	18.1
32.5 - 55.0	34.24	27	35	0.771	9.4
-20.0 - 55.0	26.31	167	371	0.450	

Table C.43. JJA 00Z TOT CBPRE 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.0 - 14.9	11.69	0	20	0.000	2.9
15.0 - 19.9	18.18	3	76	0.039	11.0
20.0 - 22.4	21.36	11	79	0.139	11.4
22.5 - 24.9	23.78	28	108	0.259	15.6
25.0 - 25.9	25.41	27	58	0.466	8.4
26.0 - 26.9	26.48	31	68	0.456	9.8
27.0 - 27.9	27.46	24	55	0.436	7.9
28.0 - 28.9	28.44	36	68	0.529	9.8
29.0 - 29.9	29.44	52	68	0.765	9.8
30.0 - 32.4	31.07	45	63	0.714	9.1
32.5 - 55.0	33.83	27	30	0.900	4.3
-10.0 - 55.0	25.34	284	693	0.410	

Table C.42. JJA 00Z SURDEP CBPRE 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.0 - 14.9	10.04	29	31	0.935	8.4
15.0 - 19.9	16.88	30	42	0.714	11.3
20.0 - 22.4	21.02	24	41	0.585	11.1
22.5 - 24.9	23.59	19	44	0.432	11.9
25.0 - 27.4	26.09	19	53	0.358	14.3
27.5 - 29.9	28.70	12	40	0.300	10.8
30.0 - 32.4	31.04	23	45	0.511	12.1
32.5 - 34.9	33.86	3	22	0.136	5.9
35.0 - 39.9	36.90	5	33	0.152	8.9
40.0 - 44.9	41.80	3	19	0.158	5.1
45.0 - 55.0	47.40	0	1	0.000	0.3
0.0 - 55.0	26.02	167	371	0.450	

Table C.41. JJA 00Z SURDEP CBPRE 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.0 - 14.9	10.25	41	42	0.976	6.1
15.0 - 19.9	17.74	41	49	0.837	7.1
20.0 - 22.4	21.40	28	42	0.667	6.1
22.5 - 24.9	23.70	37	70	0.529	10.1
25.0 - 27.4	26.15	46	103	0.447	14.9
27.5 - 29.9	28.74	28	82	0.341	11.8
30.0 - 32.4	30.95	42	153	0.275	22.1
32.5 - 34.9	33.70	6	42	0.143	6.1
35.0 - 39.9	37.05	11	67	0.164	9.7
40.0 - 44.9	42.17	3	30	0.100	4.3
45.0 - 55.0	46.78	1	13	0.077	1.9
0.0 - 55.0	28.01	284	693	0.410	

Table C.40. JJA 00Z RH4 CBPRE 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.0 - 14.9	11.57	0	9	0.000	2.4
15.0 - 19.9	18.60	1	21	0.048	5.7
20.0 - 24.9	22.51	2	50	0.040	13.5
25.0 - 29.9	27.42	13	66	0.197	17.8
30.0 - 34.9	32.52	16	53	0.302	14.3
35.0 - 39.9	37.57	28	41	0.683	11.1
40.0 - 44.9	41.90	16	26	0.615	7.0
45.0 - 49.9	47.51	22	27	0.815	7.3
50.0 - 54.9	52.12	24	29	0.828	7.8
55.0 - 59.9	57.03	15	16	0.938	4.3
60.0 - 100.0	70.14	30	33	0.909	8.9
0.0 - 100.0	37.24	167	371	0.450	

Table C.39 JJA 00Z RH4 CBPRE 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.0 - 14.9	14.11	0	7	0.000	1.0
15.0 - 19.9	18.08	0	64	0.000	9.2
20.0 - 24.9	22.48	13	149	0.087	21.5
25.0 - 29.9	27.19	29	127	0.228	18.3
30.0 - 34.9	32.24	43	99	0.434	14.3
35.0 - 39.9	37.41	46	68	0.676	9.8
40.0 - 44.9	42.07	37	52	0.712	7.5
45.0 - 49.9	47.68	40	49	0.816	7.1
50.0 - 54.9	52.11	21	23	0.913	3.3
55.0 - 59.9	57.30	20	20	1.000	2.9
60.0 - 100.0	70.29	35	35	1.000	5.1
0.0 - 100.0	33.40	284	693	0.410	

Table C.38. JJA 00Z PW CBPRE 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.25 - 0.29	0.28	0	1	0.000	0.3
0.30 - 0.39	0.35	3	31	0.097	8.4
0.40 - 0.44	0.43	5	31	0.161	8.4
0.45 - 0.49	0.47	2	37	0.054	10.0
0.50 - 0.54	0.52	10	45	0.222	12.1
0.55 - 0.59	0.58	7	32	0.219	8.6
0.60 - 0.64	0.62	13	30	0.433	8.1
0.65 - 0.74	0.69	35	52	0.673	14.0
0.75 - 0.99	0.85	63	79	0.797	21.3
1.00 - 2.00	1.17	29	33	0.879	8.9
0.15 - 2.00	0.66	167	371	0.450	

Table C.37. JJA 00Z PW CBPRE 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.15 - 0.24	0.23	0	7	0.000	1.0
0.25 - 0.29	0.28	0	14	0.000	2.0
0.30 - 0.39	0.36	9	96	0.094	13.9
0.40 - 0.44	0.42	10	94	0.106	13.6
0.45 - 0.49	0.47	17	84	0.202	12.1
0.50 - 0.54	0.52	39	86	0.453	12.4
0.55 - 0.59	0.57	24	61	0.393	8.8
0.60 - 0.64	0.62	40	69	0.580	10.0
0.65 - 0.74	0.69	50	79	0.633	11.4
0.75 - 0.99	0.85	64	72	0.889	10.4
1.00 - 2.00	1.18	31	31	1.000	4.5
0.15 - 2.00	0.57	284	693	0.410	

Table C.36. JJA 00Z LINWS CBPRE 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.0 - -2.01	-3.26	38	47	0.809	12.7
-2.0 - -1.01	-1.42	28	38	0.737	10.2
-1.0 - -0.01	-0.58	30	54	0.556	14.6
0.0 - 0.49	0.22	13	28	0.464	7.5
0.5 - 0.99	0.65	15	25	0.600	6.7
1.0 - 1.49	1.22	19	33	0.576	8.9
1.5 - 1.99	1.68	6	24	0.250	6.5
2.0 - 2.49	2.19	9	25	0.360	6.7
2.5 - 2.99	2.75	4	14	0.286	3.8
3.0 - 3.99	3.33	2	22	0.091	5.9
4.0 - 25.00	5.99	3	61	0.049	16.4
-10.0 - 25.00	1.07	167	371	0.450	

Table C.35. JJA 00Z LINWS CBPRE 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.0 - -2.01	-3.03	20	30	0.667	4.3
-2.0 - -1.01	-1.38	26	41	0.634	5.9
-1.0 - -0.01	-0.47	60	105	0.571	15.2
0.0 - 0.49	0.18	34	64	0.531	9.2
0.5 - 0.99	0.70	45	70	0.643	10.1
1.0 - 1.49	1.19	33	75	0.440	10.8
1.5 - 1.99	1.73	32	67	0.478	9.7
2.0 - 2.49	2.20	13	41	0.317	5.9
2.5 - 2.99	2.71	8	30	0.267	4.3
3.0 - 3.99	3.45	11	55	0.200	7.9
4.0 - 25.00	5.64	2	115	0.017	16.6
-10.0 - 25.00	1.56	284	693	0.410	

Table C.34. JJA 00Z K Index CBPRE 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-25.0 - 4.9	1.33	0	6	0.000	1.6
5.0 - 9.9	7.49	1	8	0.125	2.2
10.0 - 14.9	13.01	0	18	0.000	4.9
15.0 - 17.4	16.43	3	32	0.094	8.6
17.5 - 19.9	18.68	2	36	0.056	9.7
20.0 - 22.4	21.22	12	48	0.250	12.9
22.5 - 24.9	23.80	13	40	0.325	10.8
25.0 - 27.4	26.14	30	48	0.625	12.9
27.5 - 29.9	28.66	25	37	0.676	10.0
30.0 - 39.9	34.43	74	90	0.822	24.3
40.0 - 55.0	42.91	7	8	0.875	2.2
-25.0 - 55.0	24.87	167	371	0.450	100.0

Table C.48. MJS 12Z LINWS TSTM 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.00 - -0.10	-1.18	4	12	0.333	3.3
0.00 - 1.24	0.67	14	33	0.424	9.1
1.25 - 2.49	1.92	15	43	0.349	11.9
2.50 - 2.99	2.66	5	23	0.217	6.4
3.00 - 3.99	3.43	6	28	0.214	7.8
4.00 - 4.99	4.47	5	37	0.135	10.2
5.00 - 5.99	5.57	4	22	0.182	6.1
6.00 - 6.99	6.30	1	26	0.038	7.2
7.00 - 7.99	7.38	4	28	0.143	7.8
8.00 - 9.99	8.90	2	43	0.047	11.9
10.00 - 14.99	11.47	2	50	0.040	13.9
15.00 - 25.00	16.33	0	16	0.000	4.4
-10.00 - 25.00	5.88	62	361	0.172	

Table C.49. MJS 12Z PW TSTM 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.05 - 0.14	0.12	0	2	0.000	0.3
0.15 - 0.24	0.21	2	50	0.040	7.7
0.25 - 0.29	0.27	0	65	0.000	10.0
0.30 - 0.34	0.32	2	95	0.021	14.6
0.35 - 0.39	0.37	6	75	0.080	11.5
0.40 - 0.44	0.42	10	74	0.135	11.4
0.45 - 0.49	0.47	12	71	0.169	10.9
0.50 - 0.54	0.52	9	56	0.161	8.6
0.55 - 0.59	0.57	7	37	0.189	5.7
0.60 - 0.64	0.62	11	30	0.367	4.6
0.65 - 0.74	0.69	18	46	0.391	7.1
0.75 - 0.99	0.82	21	40	0.525	6.1
1.00 - 2.00	1.10	3	10	0.300	1.5
0.05 - 2.00	0.45	101	651	0.155	

Table C.50. MJS 12Z PW TSTM 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.05 - 0.14	0.12	0	2	0.000	0.6
0.15 - 0.24	0.21	1	14	0.071	3.9
0.25 - 0.29	0.28	0	20	0.000	5.5
0.30 - 0.34	0.32	5	44	0.114	12.2
0.35 - 0.39	0.37	2	37	0.054	10.2
0.40 - 0.44	0.42	2	35	0.057	9.7
0.45 - 0.49	0.47	8	41	0.195	11.4
0.50 - 0.54	0.52	2	28	0.071	7.8
0.55 - 0.59	0.57	3	18	0.167	5.0
0.60 - 0.64	0.62	12	32	0.375	8.9
0.65 - 0.74	0.68	10	41	0.244	11.4
0.75 - 0.99	0.84	14	41	0.341	11.4
1.00 - 2.00	1.14	3	8	0.375	2.2
0.05 - 2.00	0.52	62	361	0.172	

Table C.51. MJS 12Z RH4 TSTM 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
15.0 - 24.9	22.00	0	79	0.000	12.1
25.0 - 29.9	27.53	3	94	0.032	14.4
30.0 - 34.9	32.07	2	67	0.030	10.3
35.0 - 39.9	37.14	4	77	0.052	11.8
40.0 - 44.9	42.89	7	43	0.163	6.6
45.0 - 49.9	47.41	16	73	0.219	11.2
50.0 - 54.9	52.54	10	54	0.185	8.3
55.0 - 59.9	57.63	10	35	0.286	5.4
60.0 - 69.9	64.14	24	62	0.387	9.5
70.0 - 79.9	74.62	13	37	0.351	5.7
80.0 - 89.9	85.27	10	22	0.455	3.4
90.0 - 100.0	92.51	2	8	0.250	1.2
15.0 - 100.0	44.31	101	651	0.155	

Table C.52. MJS 12Z RH4 TSTM 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	PRCNT
0.0 - 14.9	13.07	0	3	0.000	0.8
15.0 - 24.9	21.45	1	40	0.025	11.1
25.0 - 29.9	27.50	1	36	0.028	10.0
30.0 - 34.9	32.13	2	27	0.074	7.5
35.0 - 39.9	37.30	4	36	0.111	10.0
40.0 - 44.9	42.60	8	29	0.276	8.0
45.0 - 49.9	47.70	6	30	0.200	8.3
50.0 - 54.9	51.95	5	22	0.227	6.1
55.0 - 59.9	57.61	6	32	0.188	8.9
60.0 - 69.9	65.00	14	46	0.304	12.7
70.0 - 79.9	74.93	9	32	0.281	8.9
80.0 - 89.9	84.70	5	26	0.192	7.2
90.0 - 100.0	90.65	1	2	0.500	0.6
0.0 - 100.0	48.54	62	361	0.172	

Table C.53. MJS 1970-78 TOT TSTM 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.0 - 14.9	10.14	0	51	0.000	7.8
15.0 - 19.9	17.55	1	93	0.011	14.3
20.0 - 22.4	21.17	4	61	0.066	9.4
22.5 - 24.9	23.70	3	81	0.037	12.4
25.0 - 25.9	25.37	2	34	0.059	5.2
26.0 - 26.9	26.48	4	33	0.121	5.1
27.0 - 27.9	27.44	4	41	0.098	6.3
28.0 - 29.9	28.96	18	90	0.200	13.8
30.0 - 32.4	31.20	40	93	0.430	14.3
32.5 - 34.9	33.49	21	54	0.389	8.3
35.0 - 55.0	36.29	4	20	0.200	3.1
-10.0 - 55.0	24.98	101	651	0.155	

Table C.54. MJS 12Z TOT TSTM 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.0 - 14.9	10.47	1	32	0.031	8.9
15.0 - 19.9	18.15	1	35	0.029	9.7
20.0 - 22.4	21.43	2	25	0.080	6.9
22.5 - 24.9	23.61	3	41	0.073	11.4
25.0 - 25.9	25.41	1	13	0.077	3.6
26.0 - 26.9	26.52	1	16	0.063	4.4
27.0 - 27.9	27.40	3	27	0.111	7.5
28.0 - 29.9	29.08	9	47	0.191	13.0
30.0 - 32.4	31.32	21	57	0.368	15.8
32.5 - 34.9	33.41	19	53	0.358	14.7
35.0 - 55.0	36.80	1	15	0.067	4.2
-10.0 - 55.0	26.16	62	361	0.172	

Table C.55. MJS 00Z K Index TSTM 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-25.0 - -0.1	-4.28	0	19	0.000	2.8
0.0 - 4.9	2.47	0	27	0.000	4.0
5.0 - 9.9	7.65	0	63	0.000	9.4
10.0 - 12.4	11.36	0	54	0.000	8.0
12.5 - 14.9	13.79	2	50	0.040	7.4
15.0 - 17.4	16.32	2	69	0.029	10.3
17.5 - 19.9	18.62	6	86	0.070	12.8
20.0 - 22.4	21.24	10	78	0.128	11.6
22.5 - 24.9	23.55	12	71	0.169	10.6
25.0 - 27.4	26.17	20	67	0.299	10.0
27.5 - 29.9	28.68	17	39	0.436	5.8
30.0 - 32.4	31.03	9	27	0.333	4.0
32.5 - 55.0	34.13	14	22	0.636	3.3
-25.0 - 55.0	18.28	92	672	0.137	

Table C.56. MJS 00Z K Index TSTM 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-25.0 - -0.1	-4.48	0	5	0.000	1.4
0.0 - 4.9	2.86	0	9	0.000	2.5
5.0 - 9.9	7.88	0	17	0.000	4.8
10.0 - 12.4	11.30	0	8	0.000	2.3
12.5 - 14.9	13.98	0	22	0.000	6.2
15.0 - 17.4	16.29	2	28	0.071	7.9
17.5 - 19.9	18.64	3	29	0.103	8.2
20.0 - 22.4	21.16	3	47	0.064	13.3
22.5 - 24.9	23.63	4	41	0.098	11.6
25.0 - 27.4	26.21	6	45	0.133	12.7
27.5 - 29.9	28.46	7	38	0.184	10.8
30.0 - 32.4	31.02	8	34	0.235	9.6
32.5 - 55.0	34.98	15	30	0.500	8.5
-25.0 - 55.0	22.27	48	353	0.136	

Table C.57. MJS 00Z LINWS TSTM 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-5.0 - -2.1	-2.77	5	19	0.263	2.8
-2.0 - -1.1	-1.50	7	26	0.269	3.9
-1.0 - -0.1	-0.49	16	59	0.271	8.8
0.0 - 0.4	0.22	12	43	0.279	6.4
0.5 - 0.9	0.70	8	48	0.167	7.1
1.0 - 1.9	1.44	16	87	0.184	12.9
2.0 - 2.9	2.41	19	100	0.190	14.9
3.0 - 3.9	3.42	8	84	0.095	12.5
4.0 - 4.9	4.50	1	54	0.019	8.0
5.0 - 5.9	5.38	0	36	0.000	5.4
6.0 - 6.9	6.47	0	34	0.000	5.1
7.0 - 7.9	7.40	0	25	0.000	3.7
8.0 - 25.0	10.25	0	57	0.000	8.5
-5.0 - 25.0	2.98	92	672	0.137	

Table C.58. LINWS Frequency Table for 00Z MJS 1979-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-5.0 - -2.1	-2.81	5	17	0.294	4.8
-2.0 - -1.1	-1.46	7	28	0.250	7.9
-1.0 - -0.1	-0.59	14	50	0.280	14.2
0.0 - 0.4	0.25	6	32	0.188	9.1
0.5 - 0.9	0.70	5	28	0.179	7.9
1.0 - 1.9	1.45	6	46	0.130	13.0
2.0 - 2.9	2.49	3	45	0.067	12.7
3.0 - 3.9	3.44	0	31	0.000	8.8
4.0 - 4.9	4.35	1	15	0.067	4.2
5.0 - 5.9	5.42	0	16	0.000	4.5
6.0 - 6.9	6.43	0	14	0.000	4.0
7.0 - 7.9	7.42	0	9	0.000	2.5
8.0 - 25.0	9.51	1	22	0.045	6.2
-5.0 - 25.0	2.02	48	353	0.136	

Table C.59. MJS 00Z PW TSTM 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.05 - 0.14	0.12	0	7	0.000	1.0
0.15 - 0.24	0.21	1	60	0.017	8.9
0.25 - 0.29	0.27	1	74	0.014	11.0
0.30 - 0.34	0.32	6	88	0.068	13.1
0.35 - 0.39	0.37	9	98	0.092	14.6
0.40 - 0.44	0.42	5	78	0.064	11.6
0.45 - 0.49	0.47	3	70	0.043	10.4
0.50 - 0.54	0.52	9	46	0.196	6.8
0.55 - 0.59	0.57	14	45	0.311	6.7
0.60 - 0.64	0.62	9	32	0.281	4.8
0.65 - 0.74	0.70	8	26	0.308	3.9
0.75 - 0.99	0.84	22	40	0.550	6.0
1.00 - 2.00	1.10	5	8	0.625	1.2
0.05 - 2.00	0.44	92	672	0.137	

Table C.60. MJS 00Z PW TSTM 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.05 - 0.14	0.13	0	3	0.000	0.8
0.15 - 0.24	0.20	0	10	0.000	2.8
0.25 - 0.29	0.28	2	16	0.125	4.5
0.30 - 0.34	0.32	1	34	0.029	9.6
0.35 - 0.39	0.37	2	35	0.057	9.9
0.40 - 0.44	0.42	1	41	0.024	11.6
0.45 - 0.49	0.47	5	37	0.135	10.5
0.50 - 0.54	0.52	2	43	0.047	12.2
0.55 - 0.59	0.57	3	28	0.107	7.9
0.60 - 0.64	0.62	6	32	0.188	9.1
0.65 - 0.74	0.69	8	33	0.242	9.3
0.75 - 0.99	0.85	10	30	0.333	8.5
1.00 - 2.00	1.11	8	11	0.727	3.1
0.05 - 2.00	0.52	48	353	0.136	

Table C.61. MJS 00Z RH4 TSTM 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.0 - 24.9	21.31	1	149	0.007	22.2
25.0 - 29.9	27.24	0	110	0.000	16.4
30.0 - 34.9	32.38	7	90	0.078	13.4
35.0 - 39.9	37.34	12	85	0.141	12.6
40.0 - 44.9	42.42	14	56	0.250	8.3
45.0 - 49.9	47.60	5	34	0.147	5.1
50.0 - 54.9	52.66	12	31	0.387	4.6
55.0 - 59.9	57.35	4	23	0.174	3.4
60.0 - 69.9	64.02	16	49	0.327	7.3
70.0 - 79.9	75.09	11	20	0.550	3.0
80.0 - 89.9	83.85	10	24	0.417	3.6
90.0 - 100.0	92.30	0	1	0.000	0.1
0.0 - 100.0	38.61	92	672	0.137	

Table C.75. JJA 00Z K Index 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.0 - -0.1	-2.15	0	2	0.000	0.3
0.0 - 4.9	2.74	0	7	0.000	1.0
5.0 - 9.9	8.14	0	20	0.000	2.9
10.0 - 14.9	13.14	0	74	0.000	10.7
15.0 - 19.9	17.81	10	158	0.063	22.8
20.0 - 22.4	21.23	8	107	0.075	15.4
22.5 - 24.9	23.63	17	112	0.152	16.2
25.0 - 27.4	26.25	18	82	0.220	11.8
27.5 - 29.9	28.54	22	53	0.415	7.6
30.0 - 32.4	31.12	17	41	0.415	5.9
32.5 - 34.9	33.74	10	16	0.625	2.3
35.0 - 39.9	36.58	11	20	0.550	2.9
40.0 - 50.0	40.90	1	1	1.000	0.1
-10.0 - 50.0	21.84	114	693	0.165	

Table C.74. JJA 12Z TOT TSTM 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-5.0 - 19.9	15.44	1	53	0.019	14.1
20.0 - 24.9	22.82	6	83	0.072	22.1
25.0 - 25.9	& 25.49	0	10	0.000	2.7
26.0 - 26.9	26.53	3	31	0.097	8.2
27.0 - 27.9	27.46	7	29	0.241	7.7
28.0 - 28.9	28.40	11	34	0.324	9.0
29.0 - 29.9	29.40	9	33	0.273	8.8
30.0 - 30.9	30.45	11	37	0.297	9.8
31.0 - 31.9	31.37	9	26	0.346	6.9
32.0 - 32.9	32.19	9	13	0.692	3.5
33.0 - 34.9	33.88	8	22	0.364	5.9
35.0 - 37.4	35.73	1	4	0.250	1.1
37.5 - 50.0	38.00	0	1	0.000	0.3
-5.0 - 50.0	26.09	75	376	0.199	

Table C.73. JJA 12Z TOT TSTM 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-5.0 - 19.9	16.52	1	94	0.011	13.7
20.0 - 24.9	22.69	7	152	0.046	22.1
25.0 - 25.9	25.36	5	48	0.104	7.0
26.0 - 26.9	26.52	7	50	0.140	7.3
27.0 - 27.9	27.43	16	70	0.229	10.2
28.0 - 28.9	28.46	22	82	0.268	11.9
29.0 - 29.9	29.37	17	53	0.321	7.7
30.0 - 30.9	30.44	14	44	0.318	6.4
31.0 - 31.9	31.44	17	41	0.415	6.0
32.0 - 32.9	32.43	9	32	0.281	4.7
33.0 - 34.9	33.76	9	18	0.500	2.6
35.0 - 37.4	35.50	2	3	0.667	0.4
37.5 - 50.0	37.50	1	1	1.000	0.1
-5.0 - 50.0	25.83	127	688	0.185	

Table C.72. JJA 12Z RH4 TSTM 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	PRCNT
0.0 - 14.9	9.65	0	2	0.000	0.5
15.0 - 24.9	21.57	0	53	0.000	14.1
25.0 - 29.9	27.58	1	41	0.024	10.9
30.0 - 34.9	32.37	5	37	0.135	9.8
35.0 - 39.9	37.39	4	47	0.085	12.5
40.0 - 44.9	42.61	8	50	0.160	13.3
45.0 - 49.9	47.38	12	39	0.308	10.4
50.0 - 54.9	52.33	11	35	0.314	9.3
55.0 - 59.9	56.87	7	18	0.389	4.8
60.0 - 69.9	64.92	13	29	0.448	7.7
70.0 - 79.9	75.14	10	20	0.500	5.3
80.0 - 89.9	83.45	3	4	0.750	1.1
90.0 - 100.0	90.10	1	1	1.000	0.3
0.0 - 100.0	42.26	75	376	0.199	

Table C.71. JJA 12Z RH4 TSTM 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
15.0 - 24.9	21.53	1	122	0.008	17.7
25.0 - 29.9	27.69	5	97	0.052	14.1
30.0 - 34.9	32.65	3	88	0.034	12.8
35.0 - 39.9	37.42	10	76	0.132	11.0
40.0 - 44.9	42.65	7	76	0.092	11.0
45.0 - 49.9	47.48	22	64	0.344	9.3
50.0 - 54.9	52.32	17	53	0.321	7.7
55.0 - 59.9	56.96	18	38	0.474	5.5
60.0 - 69.9	64.76	26	44	0.591	6.4
70.0 - 79.9	74.55	11	21	0.524	3.1
80.0 - 89.9	85.16	6	8	0.750	1.2
90.0 - 100.0	97.50	1	1	1.000	0.1
0.0 - 100.0	39.88	127	688	0.185	

Table C.70. JJA 12Z PW TSTM 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.00 - 0.39	0.33	0	43	0.000	11.4
0.40 - 0.49	0.45	2	76	0.026	20.2
0.50 - 0.54	0.52	3	22	0.136	5.9
0.55 - 0.59	0.57	8	40	0.200	10.6
0.60 - 0.64	0.62	3	28	0.107	7.4
0.65 - 0.69	0.67	8	32	0.250	8.5
0.70 - 0.74	0.72	6	29	0.207	7.7
0.75 - 0.79	0.77	5	20	0.250	5.3
0.80 - 0.84	0.83	6	16	0.375	4.3
0.85 - 0.89	0.87	3	13	0.231	3.5
0.90 - 0.94	0.92	6	11	0.545	2.9
0.95 - 0.99	0.97	1	5	0.200	1.3
1.00 - 1.50	1.14	24	41	0.585	10.9
0.00 - 1.50	0.65	75	376	0.199	

Table C.69. JJA 12Z PW TSTM 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.00 - 0.39	0.34	2	123	0.016	17.9
0.40 - 0.49	0.44	9	145	0.062	21.1
0.50 - 0.54	0.52	4	70	0.057	10.2
0.55 - 0.59	0.57	8	61	0.131	8.9
0.60 - 0.64	0.62	13	59	0.220	8.6
0.65 - 0.69	0.68	11	47	0.234	6.8
0.70 - 0.74	0.72	8	32	0.250	4.7
0.75 - 0.79	0.77	8	28	0.286	4.1
0.80 - 0.84	0.82	10	26	0.385	3.8
0.85 - 0.89	0.87	6	15	0.400	2.2
0.90 - 0.94	0.92	10	25	0.400	3.6
0.95 - 0.99	0.97	8	11	0.727	1.6
1.00 - 1.50	1.13	30	46	0.652	6.7
0.00 - 1.50	0.60	127	688	0.185	

Table C.68. JJA 12Z LINWS TSTM 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-3.0 - -2.1	-2.80	1	2	0.500	0.5
-2.0 - -1.1	-1.54	8	11	0.727	2.9
-1.0 - -0.1	-0.52	3	10	0.300	2.7
0.0 - 0.9	0.44	9	20	0.450	5.3
1.0 - 1.4	1.27	0	11	0.000	2.9
1.5 - 1.9	1.68	5	12	0.417	3.2
2.0 - 2.4	2.16	0	5	0.000	1.3
2.5 - 2.9	2.66	0	5	0.000	1.3
3.0 - 3.9	3.51	1	12	0.083	3.2
4.0 - 4.9	4.52	3	15	0.200	4.0
5.0 - 6.9	6.05	11	36	0.306	9.6
7.0 - 9.9	8.55	24	110	0.218	29.3
10.0 - 30.0	12.52	10	127	0.079	33.8
-3.0 - 30.0	7.71	75	376	0.199	

Table C.67. JJA 12Z LINWS TSTM 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-3.0 - -2.1	-2.10	2	2	1.000	0.3
-2.0 - -1.1	-1.47	4	6	0.667	0.9
-1.0 - -0.1	-0.38	13	25	0.520	3.6
0.0 - 0.9	0.52	15	37	0.405	5.4
1.0 - 1.4	1.21	15	39	0.385	5.7
1.5 - 1.9	1.76	17	38	0.447	5.5
2.0 - 2.4	2.20	9	45	0.200	6.5
2.5 - 2.9	2.68	11	41	0.268	6.0
3.0 - 3.9	3.46	15	86	0.174	12.5
4.0 - 4.9	4.50	15	81	0.185	11.8
5.0 - 6.9	5.85	9	115	0.078	16.7
7.0 - 9.9	8.27	2	108	0.019	15.7
10.0 - 30.0	11.83	0	65	0.000	9.4
-3.0 - 30.0	4.82	127	688	0.185	100.0

Table C.66. JJA 12Z K Index 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.0 - -0.1	-2.65	0	6	0.000	1.6
0.0 - 4.9	2.86	1	17	0.059	4.5
5.0 - 9.9	8.14	0	38	0.000	10.1
10.0 - 14.9	12.82	1	50	0.020	13.3
15.0 - 19.9	16.93	8	62	0.129	16.5
20.0 - 22.4	21.38	4	28	0.143	7.4
22.5 - 24.9	23.72	5	41	0.122	10.9
25.0 - 27.4	26.13	15	38	0.395	10.1
27.5 - 29.9	28.80	10	26	0.385	6.9
30.0 - 32.4	31.07	6	20	0.300	5.3
32.5 - 34.9	33.45	10	24	0.417	6.4
35.0 - 39.9	37.15	13	22	0.591	5.9
40.0 - 50.0	40.60	2	4	0.500	1.1
-10.0 - 50.0	20.61	75	376	0.199	

Table C.65. JJA 12Z K Index TSTM 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.0 - -0.1	-1.83	0	10	0.000	1.5
0.0 - 4.9	2.58	0	12	0.000	1.7
5.0 - 9.9	7.60	2	78	0.026	11.3
10.0 - 14.9	12.42	8	134	0.060	19.5
15.0 - 19.9	17.34	15	144	0.104	20.9
20.0 - 22.4	21.28	11	58	0.190	8.4
22.5 - 24.9	23.77	16	79	0.203	11.5
25.0 - 27.4	26.34	11	46	0.239	6.7
27.5 - 29.9	28.54	23	51	0.451	7.4
30.0 - 32.4	31.05	14	35	0.400	5.1
32.5 - 34.9	33.34	14	24	0.583	3.5
35.0 - 40.0	36.69	13	17	0.765	2.5
-10.0 - 40.0	18.98	127	688	0.185	

Table C.64. TOT TSTM Frequency Table for 00Z MJS 1979-83.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.0 - 14.9	11.54	0	25	0.000	7.1
15.0 - 19.9	17.92	1	33	0.030	9.3
20.0 - 22.4	21.14	0	25	0.000	7.1
22.5 - 24.9	23.54	1	34	0.029	9.6
25.0 - 25.9	25.44	1	27	0.037	7.6
26.0 - 26.9	26.56	0	16	0.000	4.5
27.0 - 27.9	27.47	3	20	0.150	5.7
28.0 - 29.9	29.08	14	57	0.246	16.1
30.0 - 32.4	31.03	14	71	0.197	20.1
32.5 - 34.9	33.53	12	39	0.308	11.0
35.0 - 55.0	35.85	2	6	0.333	1.7
-10.0 - 55.0	26.21	48	353	0.136	

Table C.63. MJS 00Z TOT TSTM 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.0 - 14.9	10.15	0	59	0.000	8.8
15.0 - 19.9	17.86	0	85	0.000	12.6
20.0 - 22.4	21.41	0	73	0.000	10.9
22.5 - 24.9	23.74	5	77	0.065	11.5
25.0 - 25.9	25.52	3	31	0.097	4.6
26.0 - 26.9	26.53	4	44	0.091	6.5
27.0 - 27.9	27.44	12	54	0.222	8.0
28.0 - 29.9	28.89	22	107	0.206	15.9
30.0 - 32.4	31.04	23	89	0.258	13.2
32.5 - 34.9	33.50	17	40	0.425	6.0
35.0 - 55.0	38.12	6	13	0.462	1.9
-10.0 - 55.0	24.76	92	672	0.137	

Table C.62. MJS 00Z RH4 TSTM 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
15.0 - 24.9	22.50	0	50	0.000	14.2
25.0 - 29.9	27.23	0	41	0.000	11.6
30.0 - 34.9	32.54	3	51	0.059	14.4
35.0 - 39.9	37.12	2	43	0.047	12.2
40.0 - 44.9	42.41	5	25	0.200	7.1
45.0 - 49.9	47.64	7	34	0.206	9.6
50.0 - 54.9	52.78	3	23	0.130	6.5
55.0 - 59.9	57.28	8	24	0.333	6.8
60.0 - 69.9	63.24	7	23	0.304	6.5
70.0 - 79.9	74.04	10	25	0.400	7.1
80.0 - 89.9	84.82	3	13	0.231	3.7
90.0 - 100.0	90.10	0	1	0.000	0.3
0.0 - 100.0	43.24	48	353	0.136	

Table C.76. JJA 00Z K Index TSTM 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-15.0 - -0.1	-12.10	0	1	0.000	0.3
0.0 - 4.9	4.02	0	5	0.000	1.3
5.0 - 9.9	7.49	0	8	0.000	2.2
10.0 - 14.9	13.01	0	18	0.000	4.9
15.0 - 19.9	17.63	3	68	0.044	18.3
20.0 - 22.4	21.22	1	48	0.021	12.9
22.5 - 24.9	23.80	5	40	0.125	10.8
25.0 - 27.4	26.14	6	48	0.125	12.9
27.5 - 29.9	28.66	7	37	0.189	10.0
30.0 - 32.4	31.03	15	28	0.536	7.5
32.5 - 34.9	33.92	10	27	0.370	7.3
35.0 - 39.9	37.53	20	35	0.571	9.4
40.0 - 50.0	42.91	4	8	0.500	2.2
-15.0 - 50.0	24.87	71	371	0.191	

Table C.77. JJA 00Z LINWS TSTM 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.0 - -2.1	-3.03	9	30	0.300	4.3
-2.0 - -1.1	-1.38	11	41	0.268	5.9
-1.0 - -0.6	-0.77	7	41	0.171	5.9
-0.5 - -0.1	-0.28	16	64	0.250	9.2
0.0 - 0.4	0.18	8	64	0.125	9.2
0.5 - 0.9	0.70	18	70	0.257	10.1
1.0 - 1.4	1.19	20	75	0.267	10.8
1.5 - 1.9	1.73	10	67	0.149	9.7
2.0 - 2.4	2.20	6	41	0.146	5.9
2.5 - 2.9	2.71	2	30	0.067	4.3
3.0 - 3.9	3.45	6	55	0.109	7.9
4.0 - 4.9	4.43	1	51	0.020	7.4
5.0 - 30.0	6.60	0	64	0.000	9.2
-10.0 - 30.0	1.56	114	693	0.165	

Table C.78. JJA 00Z LINWS TSTM 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-10.0 - -2.1	-3.26	25	47	0.532	12.7
-2.0 - -1.1	-1.42	9	38	0.237	10.2
-1.0 - -0.6	-0.81	8	29	0.276	7.8
-0.5 - -0.1	-0.31	6	25	0.240	6.7
0.0 - 0.4	0.22	6	28	0.214	7.5
0.5 - 0.9	0.65	2	25	0.080	6.7
1.0 - 1.4	1.22	6	33	0.182	8.9
1.5 - 1.9	1.68	2	24	0.083	6.5
2.0 - 2.4	2.19	3	25	0.120	6.7
2.5 - 2.9	2.75	1	14	0.071	3.8
3.0 - 3.9	3.33	1	22	0.045	5.9
4.0 - 4.9	4.41	2	22	0.091	5.9
5.0 - 30.0	6.87	0	39	0.000	10.5
-10.0 - 30.0	1.07	71	371	0.191	

Table C.79. JJA 00Z PW TSTM 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.00 - 0.39	0.34	0	117	0.000	16.9
0.40 - 0.49	0.45	11	178	0.062	25.7
0.50 - 0.54	0.52	9	86	0.105	12.4
0.55 - 0.59	0.57	9	61	0.148	8.8
0.60 - 0.64	0.62	12	69	0.174	10.0
0.65 - 0.69	0.67	8	47	0.170	6.8
0.70 - 0.74	0.72	10	32	0.313	4.6
0.75 - 0.79	0.76	6	19	0.316	2.7
0.80 - 0.84	0.82	10	18	0.556	2.6
0.85 - 0.89	0.87	5	13	0.385	1.9
0.90 - 0.94	0.92	5	9	0.556	1.3
0.95 - 0.99	0.97	9	13	0.692	1.9
1.00 - 2.00	1.18	20	31	0.645	4.5
0.00 - 2.00	0.56	114	693	0.165	

Table C.80. JJA 00Z PW TSTM 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.00 - 0.39	0.35	0	32	0.000	8.6
0.40 - 0.49	0.45	2	68	0.029	18.3
0.50 - 0.54	0.52	1	45	0.022	12.1
0.55 - 0.59	0.58	3	32	0.094	8.6
0.60 - 0.64	0.62	4	30	0.133	8.1
0.65 - 0.69	0.67	9	35	0.257	9.4
0.70 - 0.74	0.72	4	17	0.235	4.6
0.75 - 0.79	0.77	5	23	0.217	6.2
0.80 - 0.84	0.82	4	15	0.267	4.0
0.85 - 0.89	0.87	6	16	0.375	4.3
0.90 - 0.94	0.92	5	12	0.417	3.2
0.95 - 0.99	0.96	6	13	0.462	3.5
1.00 - 2.00	1.17	22	33	0.667	8.9
0.00 - 2.00	0.66	71	371	0.191	

Table C.81. JJA 00Z RH4 TSTM 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.0 - 24.9	20.93	3	220	0.014	31.7
25.0 - 29.9	27.19	10	127	0.079	18.3
30.0 - 34.9	32.24	11	99	0.111	14.3
35.0 - 39.9	37.41	18	68	0.265	9.8
40.0 - 44.9	42.07	13	52	0.250	7.5
45.0 - 49.9	47.68	14	49	0.286	7.1
50.0 - 54.9	52.11	10	23	0.435	3.3
55.0 - 59.9	57.30	12	20	0.600	2.9
60.0 - 69.9	63.81	13	17	0.765	2.5
70.0 - 79.9	73.10	6	12	0.500	1.7
80.0 - 100.0	83.05	4	6	0.667	0.9
0.0 - 100.0	33.37	114	693	0.165	

Table C.82. JJA 00Z RH4 TSTM 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
0.0 - 24.9	20.25	0	80	0.000	21.6
25.0 - 29.9	27.42	5	66	0.076	17.8
30.0 - 34.9	32.52	5	53	0.094	14.3
35.0 - 39.9	37.57	7	41	0.171	11.1
40.0 - 44.9	41.90	6	26	0.231	7.0
45.0 - 49.9	47.51	8	27	0.296	7.3
50.0 - 54.9	52.12	10	29	0.345	7.8
55.0 - 59.9	57.03	9	16	0.563	4.3
60.0 - 69.9	63.77	11	18	0.611	4.9
70.0 - 79.9	74.46	6	9	0.667	2.4
80.0 - 100.0	82.80	4	6	0.667	1.6
0.0 - 100.0	37.21	71	371	0.191	

Table C.83. JJA 00Z TOT TSTM 1970-78 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-20.0 - 14.9	11.69	0	20	0.000	2.9
15.0 - 19.9	18.18	1	76	0.013	11.0
20.0 - 22.4	21.36	2	79	0.025	11.4
22.5 - 24.9	23.78	12	108	0.111	15.6
25.0 - 25.9	25.41	12	58	0.207	8.4
26.0 - 26.9	26.48	7	68	0.103	9.8
27.0 - 27.9	27.46	8	55	0.145	7.9
28.0 - 28.9	28.44	14	68	0.206	9.8
29.0 - 29.9	29.44	21	68	0.309	9.8
30.0 - 32.4	31.07	22	63	0.349	9.1
32.5 - 34.9	33.31	11	25	0.440	3.6
35.0 - 55.0	36.44	4	5	0.800	0.7
-20.0 - 55.0	25.34	114	693	0.165	

Table C.84. JJA 00Z TOT TSTM 1979-83 Frequency Table.

ONE TENTH R CLASS LIMITS	MEAN	OCC NO.	TOT NO.	ONE TENTH R CLASS FREQ	ONE TENTH R CLASS PRCNT
-20.0 - 14.9	9.01	0	16	0.000	4.3
15.0 - 19.9	17.74	0	30	0.000	8.1
20.0 - 22.4	21.41	3	33	0.091	8.9
22.5 - 24.9	23.60	0	41	0.000	11.1
25.0 - 25.9	25.48	1	19	0.053	5.1
26.0 - 26.9	26.52	6	25	0.240	6.7
27.0 - 27.9	27.49	8	35	0.229	9.4
28.0 - 28.9	28.51	8	39	0.205	10.5
29.0 - 29.9	29.48	12	31	0.387	8.4
30.0 - 32.4	30.98	22	67	0.328	18.1
32.5 - 34.9	33.52	5	26	0.192	7.0
35.0 - 55.0	36.32	6	9	0.667	2.4
-20.0 - 55.0	26.31	71	371	0.191	

APPENDIX D

LIST OF EOUATIONS USED AND CORRELATION MATRICES FOR THE DEPENDENT AND INDEPENDENT VARIABLES

Table D.1. Equations Used.

MJS CBPRE Equations

12Z Equation 30, 1970-78 MJS dependent data sample size = 651, correlation = 0.6683, percent reduction in variance = 44.47, MJS 1970-83: S.S. = 0.63, percent correct = 81.3.

R(30) = 0.02391 + 0.00764*SURDEP + 0.00338*V5 - 0.002421*U5 + 0.00352*V7 + 0.02998*UII + 0.01160*RH4 - 0.02602*LINWS

12Z Equation 31, 1970-78 screened MJS dependent data sample size = 566, correlation = 0.6404, percent reduction in variance = 40.06, MJS 1970-83: S.S. = 0.63, percent correct = 81.3.

R(31) = -0.05762 + 0.00428*KTOT + 0.00911*SURDEP + 0.00362*V5 - 0.00220*U5 + 0.00290*V7 + 0.02408*UII + 0.00946*RH4 - 0.00339*UI - 0.01893*LINWS

00Z Equation 34, 1970-78 screened MJS dependent data sample size = 541, correlation = 0.7166, percent reduction in variance = 50.15, MJS 1970-83: S.S. = 0.71, percent correct = 85.6.

R(34) = -0.41608 - 0.02609*K + 0.02026*KTOT + 0.57186*PW - 0.02205*SURDEP + 0.05166*T85 - 0.05166*T50 + 0.01171*DEP50 - 0.0009998*H85 + 0.00244*V5 + 0.00164*U5 - 0.00528*V7 + 0.00837*VSUR + 0.02746*CONVI + 0.00947*RH4

00Z Equation 11, 1980-83 May-September dependent data sample size = 566, correlation = 0.6879, percent reduction in variance = 46.09, MJS 1970-83: S.S. = 0.71, percent correct = 85.7.

R(11) = 0.96455 + 0.00625*K + 0.84450*PW - 0.01924*SURDEP + 0.03164*T85 - 0.05015*T50 - 0.0012739*H85 + 0.00226*V5 - 0.00259*U5 - 0.00657*RH4 + 0.00489*UI - 0.00481*LINWS + 0.14671*POSAR

JJA CBPRE Equatior

12Z Equation 27, 1970-78 dependent data sample size = 688, correlation = 0.6581, percent reduction in variance = 42.75, JJA 1970-83: S.S. = 0.57, percent correct = 78.8.

R(27) = 1.90590 + 0.01203*SURT - 0.000754*DEP70 - 0.0012275*H85 + 0.00169*V5 - 0.00469*U5 + 0.02778*UII + 0.00398*VSUR + 0.01025*RH4 - 0.01017*LINWS + 0.11552*POSAR - 0.00892*DEP40

12Z Equation 16, 1980-83 May-September dependent data sample size = 574, correlation = 0.6351, percent reduction in variance = 39.06, JJA 1970-83: S.S. = 0.53, percent correct = 76.7.

R(16) = 2.45522 + 0.00603*TOT + 0.45404*PW + 0.01290*SURT - 0.01410*SURTD - 0.02107*TD85 - 0.00176*HD7085 + 0.00393*V5 - 0.00778*U5 + 0.01067*RH4 + 0.00489*UI - 0.00481*LINWS + 0.14671*POSAR

Equation 33, 1970-78 JJA dependent data sample size = 693, correlation = 937, percent reduction in variance = 47.56, MJS 1970-83: S.S. = 0.64, cent correct = 82.7.

3) = 2.97187 + 0.01491*K - 0.01499*SURDEP + 0.01544*T85 - 0.0020601*H85 - 0574*V7 + 0.00599*VSUR + 0.01856*CONVI + 0.00964*RH4 - 0.02084*LINWS

Equation 11, 1980-83 dependent data sample size = 566, correlation = 879, percent reduction in variance = 46.09, JJA 1970-83: S.S. = 0.61, cent correct = 81.5.

11) = same as MJS equation 11 above

S TSTM equations

Z Equation 37, 1970-78 MJS screened data sample size = 212, correlation = 4992, percent reduction in variance = 21.19, MJS 1970-83: S.S. = 0.31, rcent correct = 78.1.

37) = 3.59814 + 0.52291*PW - 0.04876*TD85 + 0.02766*TD70 - 0.0019722*H85 + 00399*V7 - 0.03804*UII - 0.00924*VSUR - 0.02241*USUR + 0.26489*POSAR - 02647*DEP40

Z Equation 44, 1970-78 MJS dependent data sample size = 651, correlation = 4676, percent reduction in variance = 20.89, MJS 1970-83: S.S. = 0.39, rcent correct = 82.9.

44) = 1.37845 - 0.00406*TOT - 0.01108*TD85 + 0.01790*TD70 - 0.0008778*H85 - .01182*USUR + 0.00632*RH4 + 0.19403*POSAR

Z Equation 21, 1980-83 May-September screened dependent data sample size = 2, correlation = 0.5077, percent reduction in variance = 23.89, MJS 1970-83: .S. = 0.32, percent correct = 82.1.

21) = 0.02860 + 0.01156*KTOT - 0.00854*DEP50 + 0.00641*V5 + 0.00917*U7 + .00547*TD40

Z Equation 45, 1970-78 MJS dependent data sample size = 672, correlation = .5013, percent reduction in variance = 24.28, MJS 1970-83: S.S. = 0.39, rcent correct = 82.9.

45) = 0.13726 - 0.00733*TOT + 1.06834*PW - 0.0263*SURT + 0.01534*DEP85 - .00819*USUR - 0.03042*LINWS - 0.00309*TD40

JA TSTM equations

Z Equation 41, 1970-78 screened May-September sample size = 466 cases, rrelation = 0.5187, percent reduction in variance = 25.14, JJA 1970-83: S.S. 0.40, percent correct = 80.3.

41) = -72.68358 - 0.00727*K + 0.01404*TOT + 1.08983*PW + 0.10479*SURP - .02850*TD85 - 0.01250*H85 + 0.00466*V7 - 0.00396*U7 - 0.01414*USUR +

0.08288*POSAR - 0.02098*DEP40

12Z Equation 46, 1970-78 JJA sample size = 688 cases, correlation = 0.5341, percent reduction in variance = 27.58, JJA 1970-83: S.S. = 0.45, percent correct = 81.7.

R(46) = -0.29567 - 0.00320*K + 0.45172*PW - 0.01059*TD85 + 0.00437*V7 -0.00340*U7 - 0.00744*USUR - 0.00821*RH4 + 0.09149*POSAR - 0.00661*DEP40

00Z Equation36, 1970-78 screened JJA sample size = 228 cases, correlation = 0.4985, percent reduction in variance = 23.50, JJA 1970-83: S.S. = 0.47, percent correct = 84.1

R(36) = 6.49054 + 0.01434*TOT + 0.72906*PW - 0.0021745*H70 - 0.01282*USUR

00Z Equation 47, 1970-78 JJA sample size = 693 cases, correlation = 0.5301, percent reduction in variance = 27.46, JJA 1970-83: S.S. = 0.48, percent correct = 84.4.

R(47) = 0.29502 + 0.9666*PW - 0.03995*SURT + 0.02480*DEP85 - 0.00458*USUR - 0.00081472*RH4 - 0.01339*LINWS + 0.06109*POSAR

Table D.2. MJS CBPRE 12Z Equation 30.

a. Coefficient matrix.

STEP NO.	CONST	LINWS	RH4	V7	UII	V5	U5	SURDEP
1	0.91546	-0.06725						
2	0.31723	-0.04247	0.00964					
DEL %		-36.8						
3	0.16455	-0.03201	0.01091	0.00875				
DEL %		-24.6	+13.2					
4	0.13143	-0.03215	0.01030	0.00824	0.03918			
DEL %		+0.4	-5.6	-5.8				
5	0.12178	-0.03012	0.01012	0.00473	0.03922	0.00300		
DEL %		-6.3	-1.7	-42.6	+0.1			
6.	0.14182	-0.02843	0.01038	0.00427	0.03504	0.00346	-0.0021972	
DEL %		-8.5	+11.7	-17.6	-14.4	-2.3	+10.1	
7.	0.02391	-0.02602	0.01160	0.00352	0.02998	0.00338	-0.002421	0.00764
DEL %		-8.5	+11.7	-17.6	-14.4	-2.3	+10.1	

b. Correlation matrix.

Predictor	Predictor. i_3	LINWS	RH4	V7	UII	V5	U5	SURDEP
i_3	1.0							
LINWS	-0.5619	1.0						
RH4	0.5694	-0.6122	1.0					
V7	0.2779	0.2582	0.0500	1.0				
UII	0.2500	-0.1868	0.2544	0.1306	1.0			
V5	0.3574	-0.3894	0.1792	0.7149	0.1266	1.0		
U5	-0.1056	-0.1936	-0.0009	-0.0495	-0.1293	0.0635	1.0	
SURDEP	-0.0257	-0.0105	-0.3698	0.3218	0.0738	0.2304	0.0517	1.0

A	=	SURFACE PRESSURE (MB)
B	=	SURFACE TEMPERATURE (C)
D	=	DEW POINT TEMPERATURE (C)
DPMP()	=	DEW POINT (C) MANDATORY PRESSURE LEVELS
LIFT	=	SUBROUTINE NAME
PLCL	=	PRESSURE AT LIFTED CONDENSATION LEVEL
PLL	=	PRESSURE AT LIFTED CONDENSATION LEVEL
PLM()	=	PRESSURE (MB)
SHLCL	=	LIFTED CONDENSATION LEVEL (WHIT'S METHOD)
T	=	TEMPERATURE
TC	=	CONVECTIVE (CRITICAL) TEMPERATURE
THETA	=	TEMPERATURE (CORRECTED)
TLCL	=	TEMPERATURE AT LIFTED CONDENSATION LEVEL
TLL	=	TEMPERATURE AT LIFTED CONDENSATION LEVEL
TMP()	=	TEMPERATURE (C) MANDATORY PRESSURE LEVEL
WI	=	"WHIT" INDEX

SUBROUTINE LILCL

ALI	=	LIFTED INDEX (NWS METHOD)
AP	=	DIFFERENCE IN MILLIBARS TO DETERMINE MIX. RATIO HEIGHT
APO	=	DIFFERENCE IN MILLIBARS TO DETERMINE MIX. RATIO HEIGHT
D	=	DEW POINT TEMPERATURE (C)
I	=	DO LOOP COUNTER
IFLG	=	FLAG
IW	=	COUNTER FOR WIND DATA
LIFT	=	SUBROUTINE NAME
LILCL	=	SUBROUTINE NAME
MMXRT	=	SUBROUTINE NAME
PI	=	PRESSURE AT THE LCL
PLCL	=	PRESSURE AT LIFTED CONDENSATION LEVEL
PPL()	=	PRESSURE (MB)
SL	=	TEMPERATURE SLOPE
T	=	TEMPERATURE (C)
THETA	=	TEMPERATURE (CORRECTED)
TLCL	=	TEMPERATURE AT LIFTED CONDENSATION LEVEL
TTD()	=	DEW POINT TEMPERATURE (C)
TTE()	=	TEMPERATURE (C)
XT	=	TEMPERATURE (C)
ZD	=	DEW POINT TEMPERATURE (C)

SUBROUTINE ULCL

A	=	SURFACE PRESSURE (MB)
B	=	SURFACE TEMPERATURE (C)
D	=	DEW POINT TEMPERATURE (C)
LIFT	=	SUBROUTINE NAME
PLCL	=	PRESSURE AT LIFTED CONDENSATION LEVEL
PLL	=	PRESSURE AT LIFTED CONDENSATION LEVEL
PLM()	=	PRESSURE (MB)
T	=	TEMPERATURE (C)
T300	=	500MB LCL TEMPERATURE RASIED TO 300MB
T400	=	500MB LCL TEMPERATURE RASIED TO 400MB

TOTALS	=	SUBROUTINE NAME
ULCL	=	SUBROUTINE NAME
WIND	=	SUBROUTINE NAME
Y	=	HEIGHT ABOVE GROUND LEVEL (POSITIVE AREA)
YES	=	ANSWER TO RESPONSE (CHARACTER)

SUBROUTINE PWRH

DELTP	=	CHANGE OF PRESSURE
ISIG	=	NUMBER OF SIGNIFICANT LEVELS
J	=	DO LOOP COUNTER
MR()	=	MIXING RATIO
MRAVG	=	AVERAGE MIXING RATIO
PD	=	PRESSURE DIFFERENCE (MB)
PPL()	=	PRESSURE (MB)
PW	=	PRECIPITABLE WATER
PWRH	=	SUBROUTINE NAME
PWS	=	PRECIPITABLE WATER (SUBTOTAL)
RH()	=	RELATIVE HUMIDITY
RHAVG	=	AVERAGE RH

SUBROUTINE PWRH4

DELTP	=	CHANGE OF PRESSURE
DPRES	=	DIFFERENCE IN PRESSURE (MB)
H2O	=	PRECIPITABLE WATER
ISIG	=	TOTAL NUMBER OF INPUT SIGNIFICANT LEVELS
J	=	DO LOOP COUNTER
MR()	=	MIXING RATIO
MRAVG	=	AVERAGE MIXING RATIO
PPL()	=	PRESSURE (MB)
PWRH4	=	SUBROUTINE NAME
RH()	=	RELATIVE HUMIDITY
RHAVG	=	AVERAGE RH
SMRH	=	RELATIVE HUMIDITY (SUBTOTAL)
WP	=	PRECIPITABLE WATER

SUBROUTINE WIND

ANG	=	WIND DIRECTION MINUS 270 (DEG) CHANGED TO RADIANS
DTOR	=	DEGREES TO RADIANS ** ANG / 57.29578 **
L	=	DO LOOP COUNTER
U()	=	U-COMPONENT
UBAR	=	AVERAGE U-COMPONENT OF WIND (SFC-850MB)
V()	=	V-COMPONENT
VBAR	=	AVERAGE V-COMPONENT OF WIND (SFC-850MB)
WDMP()	=	WIND DIRECTION (DEG) MANDATORY PRESSURE LEVELS
WIND	=	SUBROUTINE NAME
WSMP()	=	WIND SPEED (KTS) MANDATORY PRESSURE LEVELS

SUBROUTINE SHLCL

A2	=	CONSTANT USED TO COMPUTE LATENT HEAT OF CONDENSATION
CALCU	=	SUBROUTINE NAME
DDD()	=	DEW POINT DEPRESSION (C)
DDMP()	=	DEW POINT DEPRESSION (C) MANDATORY PRESSURE LEVELS
DPMP()	=	DEW POINT (C) MANDATORY PRESSURE LEVELS
EPT()	=	EQUIVALENT POTENTIAL TEMPERATURE
EQMP()	=	EQUIVALENT POTENTIAL TEMPERATURE MANDATORY PRES LEVELS
ES	=	SATURATION VAPOR PRESSURE
HHT()	=	HEIGHT (M)
HTMP()	=	HEIGHT (M) MANDATORY PRESSURE LEVELS
IC	=	COUNTER
II	=	COUNTER
IPROC	=	SOUNDINGS PROCESSED
ISIG	=	TOTAL NUMBER OF INPUT SIGNIFICANT LEVELS
LHC	=	LATENT HEAT OF CONDENSATION
MR()	=	MIXING RATIO
PLM()	=	PRESSURE (MB)
PPL()	=	PRESSURE (MB)
RH()	=	RELATIVE HUMIDITY
RHMP()	=	RELATIVE HUMIDITY (%) MANDATORY PRESSURE LEVEI
SVP	=	SATURATION VAPOR PRESSURE
SVRWX	=	SUBROUTINE NAME
TAE	=	USED IN POTENTIAL TEMPERATURE COMPUTATION
TED	=	DEW POINT TEMPERATURE (K)
TEK	=	TEMPERATURE (K)
TMP()	=	TEMPERATURE (C) MANDATORY PRESSURE LEVEL
TTD()	=	DEW POINT TEMPERATURE (C)
TTE()	=	TEMPERATURE (C)
VP	=	VAPOR PRESSURE
WD()	=	WIND DIRECTION (DEG)
WDMP()	=	WIND DIRECTION (DEG) MANDATORY PRESSURE LEVELS
WS()	=	WIND SPEED (KTS)
WSMP()	=	WIND SPEED (KTS) MANDATORY PRESSURE LEVELS
X	=	FUNCTION VARIABLE

SUBROUTINE SVRWX

AREAP	=	SUBROUTINE NAME
HTMP()	=	HEIGHT (M) MANDATORY PRESSURE LEVELS
IPM	=	RESPONSE TO QUESTION (CHARACTER)
IPROC	=	SOUNDINGS PROCESSED
ISOND	=	NUMBER OF RADIOSONDES PROCESSED
LILCL	=	LIFTED CONDENSATION LEVEL (NWS METHOD)
MDAYS	=	SOUNDINGS NOT PROCESSED
POTEMP	=	SUBROUTINE NAME
PWRH	=	SUBROUTINE NAME
PWRH4	=	SUBROUTINE NAME
READF	=	READ FILE
READS	=	SUBROUTINE NAME
RESULT	=	SUBROUTINE NAME
SHLCL	=	LIFTED CONDENSATION LEVEL (WHIT'S METHOD)
SVRWX	=	SUBROUTINE NAME
THK	=	THICKNESS (700MB - 850MB)

********************* GLOSSARY (PROGRAM PRE) **************************

MAIN PROGRAM

IPROC	=	SOUNDINGS PROCESSED
MDAYS	=	SOUNDINGS NOT PROCESSED
READS	=	SUBROUTINE NAME
SITE	=	LOCATION OF RAWINSONDE RELEASE

SUBROUTINE READS

FILEN	=	INPUT FILE NAME
FILN	=	OUTPUT FILE NAME
ISOND	=	NUMBER OF RADIOSONDES PROCESSED
READF	=	SUBROUTINE NAME
READS	=	SUBROUTINE NAME

SUBROUTINE READF

CALCU	=	SUBROUTINE NAME
CB	=	CB TYPE CLOUD OBSERVED
CBPRE	=	CB TYPE CLOUD OBSERVED WITH ACCOMPANYING PRECIPITATION
FILN	=	OUTPUT FILE NAME
HHT()	=	HEIGHT (MANDATORY PRESSURE LEVEL)
I	=	DO LOOP COUNTER
ID	=	COUNTER FOR LIFTED CONDENSATION LEVEL (LCL) COMPUTATIONS
IHR	=	HOUR OR RADIOSONDE RELEASE
IMISS	=	UNPROCESSED SOUNDINGS DUE TO BAD DATA
IMON	=	MONTH
IPROC	=	SOUNDINGS PROCESSED
ISIG	=	TOTAL NUMBER OF INPUT SIGNIFICANT LEVELS
ISKL	=	FIRST OR SECOND EQUATION USED
ISTA	=	STATION NUMBER
IYR	=	RADIOSONDE RELEASE YEAR
MDAYS	=	SOUNDINGS NOT PROCESSED
ML	=	MISSING OR BAD DATA AT LEVEL
PPL()	=	PRESSURE (MB)
PRECI	=	OBSERVED PRECIPITATION
READF	=	SUBROUTINE NAME
RH()	=	RELATIVE HUMIDITY
SKILLA	=	SUBROUTINE NAME
SKILLM	=	SUBROUTINE NAME
TSPRE	=	THUNDERSTORM WITH PRECIPITATION OBSERVED
TSTM	=	TSTM OBSERVED
TTE()	=	TEMPERATURE (C)
TYPE	=	TYPE OF SOUNDING
WD()	=	WIND DIRECTION (DEG)
WS()	=	WIND SPEED (KTS)

SUBROUTINE CALCU

A0	=	CONSTANT USED TO COMPUTE LATENT HEAT OF CONDENSATION
A1	=	CONSTANT USED TO COMPUTE LATENT HEAT OF CONDENSATION

to forecast the appearance of the radiosonde observation in the morning.

The output of the program CB takes two forms;
a. a file of calculated independent data parameters and
b. contingency tables which include Heidke skill scores and percent correct for two equations. Reduced raw data files such as MJS7078M.DAT are named WMJS7078M.DAT in the independent data parameter file. If the time period is MJS and prediction equation numbers are 30 and 31, the name of the contingency table file becomes C30317078.DAT or for the JJA equations 27 and 16, the contingency table file name is C27167078.DAT.

A sample computer menu follows:

ENTER RAWINSONDE STATION NAME

KSLC

ENTER NUMBER OF DAYS

1012

ENTER MONTH/PERIOD

MJS

ENTER YEAR (S), EX:70-78

70-78

ENTER OUTPUT FILE NAME

WMJS7078M

ENTER CONTINGENCY TABLE FILE NAME

C30317078

ENTER THE FIRST EQUATION NO.

30

ENTER THE SECOND EQUATION NO.

31

The program now runs and in process the bad data days are identified and shown on the screen. The user entries above are underlined. Note that the file name suffixes '.DAT' are not used in the above user entries.

The glossary for terms used in the program follows on pages F.3-13. The program 'CB' appears on pages F-14 through F-38.

APPENDIX F. THE COMPUTER PROGRAM

The Fortran 77 computer program for predicting Salt Lake City cumulonimbus (CB) or precipitation and thunder for the months May through September was prepared by Computer Data Systems, Inc. The regression equations used in the program were run by the Dugway Design Review and Analysis Branch, using the BMDP statistical software 1983 edition (Reference 23).

The name of the program as used at Dugway is CB and is activated on a VAX11/780 by the command:

$ RUN CB (CR)

The program processes NCAR radiosonde data for Salt Lake City airport (KSLC). The data are for the years 1970-1981. Two more years 1982 and 1983 were manually extracted from the NWS station file at KSLC. Monthly files for the NCAR tape data are addressed by the file names:

TSLC7007.DAT for the 00Z radiosonde or
TSLCP7007.DAT for the 12Z radiosonde

where: the 70 stands for the year 1970, the seven for the month, the P for the 12Z radiosonde and the absence of the P indicates the 00Z radiosonde.

The raw data have also been combined for several years, E.G. MJS7078M.DAT is a file for all the 12Z radiosonde data for the years 1970 through 1978 and the dates May 1 through June 14 and September (MJS), or JJA7078A.DAT for the years 1970 through 1978 and the dates June 15 through August 31 (JJA). The form of the NCAR raw data is:

RAOB 24127 70 7 1 0 0 0 0 0 0

			Relative	Wind	Wind
Pressure	Height	Temperature	Humidity	Direction	Speed
mb.	m.	°C	%	degrees	mps
xxxx	xxxxxx	xxxxxx	xxxx	xxxx	xxxx

where: 24127 is the KSLC station number, 70 is the year, 7 is the month, 1 is the day, 0 is the time, GMT. The five figures after the time are either 1 or 0 for the presence or not of 0.2 or more Cumulonimbus (CB), precipitation (PRECI), CB or PRECI (CBPRE), thunder (TSTM), thunder and precipitation at the same time (TSPRE). The number of x's indicate the number of spaces allotted for each parameter.

The occurence of any of the parameters is based on the KSLC weather observations recorded every three hours. The time period considered for the 12Z radiosonde data is 12Z to 07Z. The time period considered for the 00Z radiosonde is from five hours before the observation time (19Z) to seven hours after the observation time (07Z) or noon to midnight mountain standard time. Hence, to use regression equations based on the 00Z radiosonde, it is necessary

34. I4 = dependent variable of thunder heard at the station.
35. I5 = dependent variable of thunder heard and rain observed at the same time.
36. VSUR = average of the southerly component of the surface and 850 mb winds, knots.
37. USUR = average of the westerly component of the surface and 850 mb winds, knots.
38. CONVI = convective instability = EQPT50 - (EQPT85 + EQPT70), ^{o}C, where EQPT70 = the equivalent potential temperature at 700 mb, etc.
39. RH4 = average relative humidity between the surface and 400 mb.
40. UI = a stability indicator associated with high winds: To compute the upper level instability (UI), find the LCL for a parcel lifted from 500 mb and go up the moist adiabat to 300 mb. The UI is equal to the sum of the temperature differences of the lifted parcel from the ambient temperatures at 400 mb and 300 mb: UI = (T400 - T500 parcel) + (T300 - T500 parcel), ^{o}C. (Reference 19).
41. LINWS = the lifting index calculated and broadcast by the National Weather Service. To obtain the LINWS, average the mixing ratio for the lowest 150 mb if the surface pressure is greater than 850 mb. Follow the dry adiabat from the surface temperature to the average mixing ratio line. Then follow the moist adiabat up to 500 mb. Subtract this temperature from the 500 mb temperature. If negative, the parcel will continue to rise.
42. POSAR = positive area calculated from the radiosonde. The larger the positive area, the greater the instability and the potential for thunderstorm formation, joules/m. To calculate positive area, follow the mixing ratio line through the surface dewpoint temperature to the sounding. Then follow the moist adiabat up. If points on the moist adiabat are warmer than the sounding, the the area between the moist adiabat and the sounding is the positive area. This area is calculated to the point that the moist adiabat intersects the sounding the second time.
43. Critical temperature, ^{o}C. (not used).
44. Top of the positive area, m. (not used).
45. Pressure at the convective condensation level, mb, needed as part of the routine for calculation the lifting index.

End of the third line.

46. Temperature at the convective condensation level, ^{o}C, needed to calculate the lifting index.
47. T40 = the temperature at 400 mb, ^{o}C.
48. TD40 = the 400 mb temperature, ^{o}C.
49. DEP40 = T40 - TD40, ^{o}C.
50. Result 1 = the number between 0 and 1 predicted by the first equation.
51. FY/OY = a 1 for forecast yes and observed yes, otherwise a 0.
52. FY/ON = a 1 for forecast yes and observed no, otherwise a 0.
53. FN/ON = a 1 for forecast no and observed no, otherwise a 0.
54. FN/OY = a 1 for forecast no and observed yes, otherwise a 0.
55. Result 2 = the number between 0 and 1 predicted by the second equation.
56. - 59. Same as 51 through 54 above.
60. Blank.

End of the fourth line.

Table E.1. List of Variables in the Data Files in Order of Appearance. The Format is Floating Point (F5).

1. LIW = lifting index starting with the surface temperature and dewpoint.
2. K = the K index = (T85 - T50) + TD85 - (T70 - TD70), °C.
3. TOT = the totals index = T70 + TD70 - 2T50, °C.
4. KTOT = K + TOT
5. PW = the sum of precipitable water from surface to 500 millibars (mb) in inches.
6. RH5 = the average relative humidity from surface to 500 mb in percent.
7. SURP = station pressure in mb.
8. SURT = surface temperature, °C.
9. SURTD = surface dewpoint in degrees centigrade.
10. SURDEP = the surface temperature minus the surface dewpoint, °C.
11. T85 = the temperature at 850 mb, °C.
12. TD85 = the dewpoint at 850 mb, °C.
13. DEP85 = the 850 mb temperature minus the dewpoint, °C.
14. T70 = 700 mb temperature in °C.
15. TD70 = 700 mb dewpoint in °C.

End of the first line.

16. DEP70 = the 700 mb temperature minus the dewpoint, °C.
17. T50 = 500 mb temperature, °C.
18. TD50 = 500 mb dewpoint, °C.
19. DEP50 = 500 mb temperature minus dewpoint, °C.
20. H85 = 850 mb height, m.
21. H70 = 700 mb height, m.
22. H50 = 500 mb height, m.
23. HD7085 = difference between the 700 and 850 mb heights, m.
24. V5 = southerly component of the 500 mb wind, knots.
25. U5 = westerly component of the 500 mb wind, knots.
26. V7 = southerly component of the 700 mb wind, knots.
27. U7 = westerly component of the 700 mb wind, knots.
28. UII = combination of UI and the 700 mb dewpoint depression. To use the following instructions, apply the rule that if UII is 7, stop, if UII is not seven but is 6, stop, if UII is not 6 or 7 but is equal 5, stop, etc. The definitions of UII follow: If UI is less than 2 and the 700 mb depression is more than 25, UII=7. If UI is less than three and 700 mb DEP is greater than 20, UII = 6. If UI is less than 4 and 700 DEP is greater than 15 UII = 5. If 700 DEP is greater than 10 and UI less than 5, UII = 4. If DEP is greater than 5 and UI is less than 6 UII = 3. If DEP is greater than 0 and UI is less than 7, UII = 2. If UI is equal to or greater than 7, UII =1. (Reference 20).
29. Blank.
30. Blank.

End of the second line.

31. I1 = dependent variable of 0.2 or more cumulonimbus.
32. I2 = dependent variable of precipitation.
33. I3 = dependent variable cumulonimbus or precipitation observed during the verification period.

APPENDIX E

LIST OF VARIABLES IN THE COMPUTER FORMAT

Table D.7. Single Predictor TSTM Equations.

Predictor	Equation	Correlation	% Reduction in Variance
MJS 12Z			
K	R(K) = -0.07407 + 0.01392*K	0.3756	13.976
LINWS	R(LINWS) = 0.35810 - 0.02965*LINWS	0.3406	11.466
PW	R(PW) = -0.17361 + 0.72457*PW	0.3677	13.389
RH4	R(RH4) = -0.17045 + 0.0073477*RH4	0.3615	12.934
TOT	R(TOT) = -0.27778 + 0.01733*TOT	0.3296	10.728
MJS 00Z			
K	R(K) = -0.124246 + 0.01528*K	0.3799	14.307
LINWS	R(LINWS) = 0.21908 - 0.02760*LINWS	0.2634	6.800
PW	R(PW) = -0.20369 + 0.78234*PW	0.4084	16.553
RH4	R(RH4) = -0.17002 + 0.0079485*RH4	0.3919	15.233
TOT	R(TOT) = -0.27592 + 0.01667*TOT	0.3270	10.558
JJA 12Z			
K	R(K) = -0.16661 + 0.01851*K	0.4043	16.221
LINWS	R(LINWS) = 0.38066 - 0.04070*LINWS	0.3611	12.911
PW	R(PW) = -0.29041 + 0.79805*PW	0.4596	21.008
RH4	R(RH4) = -0.31241 + 0.012461	0.4876	23.663
TOT	R(TOT) = -0.45382 + 0.02471*TOT	0.3206	10.146
JJA 00Z			
K	R(K) = -0.31206 + 0.02182*K	0.3953	15.501
LINWS	R(LINWS) = 0.21390 - 0.03177*LINWS	0.2080	4.188
PW	R(PW) = -0.30917 + 0.83419*PW	0.4622	21.246
RH4	R(RH4) = -0.26677 + 0.012926*RH4	0.4700	21.978
TOT	R(TOT) = -0.43952 + 0.02383*TOT	0.3084	9.379

Table D.6. Single Predictor CBPRE Equations.

Predictor	Equation	Correlation	% Reduction in Variance
MJS 12Z			
K	R(K) = 0.00658 + 0.02731*K	0.5356	28.576
LINWS	R(LINWS) = 0.91680 - 0.06729*LINWS	0.5619	31.466
PW	R(PW) = -0.07694 + 1.17509*PW	0.4335	18.666
RH4	R(RH4) = -0.24929 + 0.015921*RH4	0.5694	32.314
TOT	R(TOT) = -0.51994 + 0.03907*TOT	0.5403	29.078
MJS 00Z			
K	R(K) = -0.16090 + 0.03256*K	0.5615	31.430
LINWS	R(LINWS) = 0.62840 - 0.06511*LINWS	0.4310	18.451
PW	R(PW) = -0.07547 + 1.17143*PW	0.4240	17.859
RH4	R(RH4) = -0.30595 + 0.019177*RH4	0.6557	42.907
SURDEP	R(SURDEP) = 1.07639 - 0.02952*SURDEP	0.4803	22.957
TOT	R(TOT) = -0.62018 + 0.04260*TOT	0.5793	33.459
JJA 12Z			
K	R(K) = -0.13379 + 0.02957*K	0.5065	25.549
LINWS	R(LINWS) = 0.78284 - 0.07380*LINWS	0.5135	26.259
PW	R(PW) = -0.26813 + 1.16844*PW	0.5277	27.745
RH4	R(RH4) = -0.32166 + 0.01878*RH4	0.5763	33.110
TOT	R(TOT) = -0.68881 + 0.04320*TOT	0.4396	19.203
JJA 00Z			
K	R(K) = -0.49457 + 0.04141*K	0.5654	31.874
LINWS	R(LINWS) = 0.53651 - 0.08150*LINWS	0.4022	16.054
PW	R(PW) = -0.34626 + 1.33154*PW	0.5561	30.825
RH4	R(RH4) = -0.35944 + 0.02306*RH4	0.6320	39.852
SURDEP	R(SURDEP) = 1.24470 - 0.02980*SURDEP	0.4706	22.030
TOT	R(TOT) = -0.85780 + 0.05001*TOT	0.4879	23.691

TABLE D.5. JJA TSTM 12Z Equation 46.

a. Coefficient Matrix

Step No	CONSTANT	RH4	PW	DEP40	V7	USUR	U7	K	POSAR	TD85
1	-0.31241	0.012461								
2	-0.35204	0.00856	0.32809							
DEL %		-31.3								
3	-0.16393	0.00597	0.39084	-0.00864						
DEL %		-30.3	21.8							
4	-0.17091	0.00562	0.39792	-0.00906	0.00458					
DEL %		-5.9	1.8	4.9						
5	-0.19684	0.00603	0.38115	-0.00890	0.00409	-0.00783				
DEL %		7.3	-4.2	-1.8	-10.7					
6	-0.18640	0.00668	0.34248	-0.00821	0.00461	-0.00769	-0.00360			
DEL %		10.8	-10.1	-7.8	12.7	1.8				
7	-0.20941	0.00764	0.42202	-0.00742	0.00470	-0.00763	-0.00363	-0.00386		
DEL %		14.4	23.2	-9.3	2.0	-0.8	0.8			
8	-0.22999	0.00858	0.36956	-0.00673	0.00457	-0.00754	-0.00357	-0.00557	0.05671	
DEL %		12.3	-12.4	-9.3	-2.8	-1.2	-1.7	44.3		
9	-0.29567	0.00821	0.45172	-0.00661	0.00437	-0.00744	-0.00340	-0.00320	0.09149	-0.01059
DEL %		-4.3	22.2	-1.8	-4.4	-1.3	-4.8	-42.5	61.3	

b. Correlation Matrix

Predic- tor	Predictor i	RH4	PW	DEP40	V7	USUR	U7	K	POSAR	TD85
i	1.0									
RH4	0.4876	1.0								
PW	0.4596	0.8082	1.0							
DEP40	-0.3398	-0.5603	-0.3557	1.0						
V7	0.1309	0.0651	0.0450	0.0002	1.0					
USUR	-0.0401	0.1033	0.0356	0.0539	-0.1710	1.0				
U7	-0.0520	0.0416	-0.0787	0.0642	0.2051	0.0053	1.0			
K	0.4043	0.8075	0.8552	-0.3029	0.0761	0.0594	-0.0173	1.0		
POSAR	0.2716	0.3694	0.5660	-0.1826	0.0760	-0.0186	-0.0864	0.5748	1.0	
TD85	0.3600	0.6610	0.8465	-0.2480	0.0330	0.0341	-0.0544	0.8572	0.7509	1.0

Table D.4. MJS TSTM 12Z Equation 44.

a. Coefficient Matrix.

Step No	CONSTANT	TD70	RH4	POSAR	USUR	TD85	U7	H85	TOT
1	0.38299	0.02609							
2	0.12220	0.01742	0.0041771						
DEL %		-33.2							
3	-0.01639	0.01214	0.0051145	0.14005					
DEL %		-30.3	22.4						
4	-0.11129	0.00988	0.0061975	0.14450	-0.01262				
DEL %		-18.6	21.2	3.2					
5	-0.10758	0.01429	0.00657	0.19677	-0.01192	-0.00960			
DEL %		44.6	6.0	36.2	-5.5				
6	-0.08146	0.01446	0.00660	0.19189	-0.01134	-0.00975	-0.00311		
DEL %		1.2	0.5	-2.5	-4.9	1.6			
7	1.07117	0.01507	0.00567	0.17153	-0.01170	-0.00886	-0.00406	-0.00073259	
DEL %		4.2	-14.1	-10.6	3.2	-9.1	30.5		
8	1.37845	0.01790	0.00632	0.19403	-0.01182	-0.01108	-0.00432	-0.0008778	-0.00406
DEL %		18.8	11.5	13.1	1.0	25.1	6.4	19.8	

b. Correlation Matrix

Predictor	Predictor i_4	TD70	RH4	POSAR	USUR	TD85	U7	H85	TOT
i_4	1.0								
TD70	0.3801	1.0							
RH4	0.3615	0.6144	1.0						
POSAR	0.2066	0.3346	0.0081	1.0					
USUR	-0.0419	0.0112	0.2755	-0.0497	1.0				
TD85	0.2953	0.7419	0.4761	0.5978	0.0774	1.0			
U7	-0.0734	0.0035	0.0485	-0.0826	0.0874	-0.0302	1.0		
H85	-0.2047	-0.1936	-0.4018	-0.1056	-0.1716	-0.1722	-0.2581	1.0	
TOT	0.3296	0.6526	0.6505	0.2895	0.0949	0.4366	-0.0111	-0.4510	1.0

Table D.3. JJA CBPRE 12Z Equation 27.

a. Coefficient Matrix.

Step No	CONST	RH4	SURT	U5	H85	POSAR	DEP40	LINWS	UII	DEP70	V5	VSUR
1	-0.32166	0.01878										
2	-0.79358	0.016935	0.03064									
DEL %		-9.8										
3	-0.64894	0.016841	0.02658	-0.00438								
DEL %		-0.6	-13.3									
4	2.23795	0.016575	0.02194	-0.00569	-0.001846							
DEL %		-1.6	-14.6	29.9								
5	2.32897	0.01559	0.01873	-0.00523	-0.001897	0.11215						
DEL %		-5.9	-2.7	-8.1	2.8							
6	2.45298	0.01362	0.01822	-0.00477	-0.001847	0.11984	-0.00918					
DEL %		-12.6	-2.7	-8.8	-2.6	6.9						
7	2.26856	0.01350	0.01453	-0.00485	-0.0016025	0.11759	-0.00949	-0.01002				
DEL %		-0.9	-20.3	1.7	-13.2	-1.9	3.4					
8	2.27741	0.01334	0.01251	-0.00491	-0.0016134	0.11329	-0.00778	-0.01045	0.01954			
DEL %		-1.2	-13.9	1.2	0.7	-3.7	-18.0	-4.3				
9	2.68099	0.01040	0.01457	-0.00504	-0.0017427	0.11037	-0.00902	-0.01067	0.02624	-0.00731		
DEL %		-22.0	16.5	2.6	8.7	-2.6	15.9	2.1	34.3			
10	2.10840	0.01005	0.01396	-0.00516	-0.001357	0.11521	-0.00877	-0.01058	0.02758	-0.00752	0.00178	
DEL %		-3.4	-4.2	2.4	-22.1	4.4	-2.8	-0.8	5.1	2.9		
11	1.90590	0.01025	0.01203	-0.00469	-0.0012275	0.11522	-0.00892	-0.01017	0.02778	-0.00754	-0.00169	0.00398
DEL %		2.0	-13.8	-9.1	-9.5	0.0	1.7	-3.9	0.7	0.3	-5.1	

b. Correlation Matrix.

Predictor	Predictor i3	RH4	SURT	U5	H85	POSAR	DEP40	LINWS	UII	DEP70	V5	VSUR
i3	1.0											
RH4	0.5763	1.0										
SURT	0.3656	0.2299	1.0									
U5	-0.2238	-0.0982	-0.3151	1.0								
H85	-0.1964	-0.1212	-0.2594	-0.1699	1.0							
POSAR	0.3649	0.3694	0.3552	-0.2320	-0.0536	1.0						
DEP40	-0.4153	-0.5603	-0.1849	0.2561	0.0852	-0.1826	1.0					
LINWS	-0.5135	-0.6539	-0.5764	0.4356	0.2692	-0.2681	0.2838	1.0				
UII	0.3549	0.3788	0.3735	-0.0177	-0.0977	0.2593	-0.4761	-0.2442	1.0			
DEP70	-0.3698	-0.3097	0.0915	-0.0278	-0.0457	-0.2320	0.2561	0.4356	-0.0177	1.0		
V5	0.1647	0.2117	0.2060	0.0827	-0.5126	0.0195	-0.1565	-0.2681	0.2166	-0.0741	1.0	
VSUR	0.1726	-0.0185	0.4619	-0.3037	-0.2470	0.1345	-0.0085	-0.2775	0.1130	0.1614	0.1647	1.0

T500	=	500MB LCL TEMPERATURE
TC	=	CONVECTIVE (CRITICAL) TEMPERATURE (C)
TLCL	=	TEMPERATURE AT LIFTED CONDENSATION LEVEL
TLL	=	TEMPERATURE AT LIFTED CONDENSATION LEVEL
TMP()	=	TEMPERATURE (C) MANDATORY PRESSURE LEVEL
TN	=	SIGNIFICANT TEMPERATURE (300MB)
THETA	=	TEMPERATURE (C)
UI	=	UPPER LEVEL INSTABILITY INDEX
ULCL	=	SUBROUTINE NAME

SUBROUTINE LIFT

ALPF	=	500.
E	=	VAPOR PRESSURE
P	=	PRESSURE AT THE LCL (MB)
PI	=	PRESSURE AT THE LCL (MB)
R	=	UNIVERSAL GAS CONSTANT
T	=	TEMPERATURE (C)
TI	=	TEMPERATURE AT LCL (C)
TW	=	WET BULB TEMPERATURE (C)
W	=	SATURATION MIXING RATIO AT 850MB

SUBROUTINE MMXRT

D50	=	AVERAGE DEW POINT (SFC TO -50 MILLIBARS)
I	=	DO LOOP COUNTER
MMXRT	=	SUBROUTINE NAME
NN	=	DO LOOP COUNTER
P50	=	PRESSURE TO -50 MILLIBARS
PPL()	=	PRESSURE (MB)
T	=	TEMPERATURE (C)
T50	=	TEMPERATURE (C)
TD	=	DEW POINT TEMPERATURE (C)
TD1	=	CORRECTED DEW POINT TEMPERATURE (C)
TTD()	=	DEW POINT TEMPERATURE (C)
TTE()	=	TEMPERATURE (C)
XMB	=	

SUBROUTINE AREAP

A	=	SURFACE PRESSURE
A1	=	ENERGY, POSITIVE AREA
AREAP	=	SUBROUTINE NAME
B	=	SURFACE TEMPERATURE (C)
BB	=	ENERGY (JOULES)
C	=	850MB DEW POINT (C)
D	=	850MB TEMPERATURE (C)
D1	=	DEW POINT DEPRESSION
DPMP()	=	DEW POINT (C) MANDATORY PRESSURE LEVELS
E	=	700MB TEMPERATURE (C)
E1	=	SATURATION VAPOR PRESSURE AT 850MB
E2	=	SATURATION VAPOR PRESSURE AT SURFACE
HGTAGL	=	TOP OF POSITIVE AREA, HEIGHT

LCLCCL	=	SUBROUTINE NAME
P	=	PRESSURE (MB)
P2	=	PRESSURE AT CCL
PAREA	=	SUBROUTINE NAME
PLM()	=	PRESSURE (MB)
PP	=	PRESSURE (MB)
T	=	TEMPERATURE (C)
TT	=	TEMPERATURE (C)
T1	=	TEMPERATURE AT LCL
T2	=	TEMPERATURE AT CCL
TC1	=	CONVECTIVE TEMPERATURE (C)
TMP()	=	TEMPERATURE (C)
W	=	SATURATION MIXING RATIO AT 850MB
Y	=	HEIGHT ABOVE GROUND LEVEL (POSITIVE AREA)
Z	=	LAPSE RATE 300-200MB
Z1	=	LAPSE RATE 500-300MB
Z2	=	LAPSE RATE 700-500MB
Z3	=	LAPSE RATE 850-700MB
Z4	=	LAPSE RATE SURFACE-850MB

SUBROUTINE LCLCCL

A	=	SURFACE PRESSURE
B	=	SURFACE TEMPERATURE
BB	=	INCREMENTERS
D	=	DEW POINT TEMPERATURE (C)
DD	=	INCREMENTERS
E	=	400MB TEMPERATURE (C)
F	=	500MB TEMPERATURE (C)
G	=	300MB TEMPERATURE (C)
LCLCCL	=	SUBROUTINE NAME
N	=	SIGNIFICANT LEVEL NUMBER
P	=	PRESSURE AT THE LCL
P1	=	PRESSURE AT LCL
T	=	TEMPERATURE (C)
T1	=	TEMPERATURE AT LCL
T3	=	SURFACE DEW POINT (C)
X	=	FUNCTION VARIABLE
Z1	=	LAPSE RATE 500-300MB
Z2	=	LAPSE RATE 700-500MB
Z3	=	LAPSE RATE 850-700MB
Z4	=	LAPSE RATE SURFACE-850MB

SUBROUTINE PAREA

A1	=	ENERGY, POSITIVE AREA
A2	=	ENERGY, POSITIVE AREA
E4	=	SATURATION VAPOR PRESSURE
IKK	=	NORMALIZATION INDICATOR
P	=	PRESSURE AT THE LCL
PAREA	=	SUBROUTINE NAME
PP	=	PRESSURE (MB)
T	=	TEMPERATURE (C)

TT	=	TEMPERATURE (C)
X	=	FUNCTION VARIABLE
Z	=	LAPSE RATE 300-200MB
Z0	=	LATENT HEAT OF CONDENSATION
Z1	=	LAPSE RATE 500-300MB
Z2	=	LAPSE RATE 700-500MB
Z3	=	LAPSE RATE 850-700MB
ZM1	=	MOIST ADIABATIC FORMULA
ZM2	=	MOIST ADIABATIC FORMULA
ZM3	=	MOIST ADIABATIC FORMULA
ZM4	=	MOIST ADIABATIC FORMULA

SUBROUTINE HGTAGL

A	=	SURFACE PRESSURE (MB)
D	=	850MB TEMPERATURE (C)
PP	=	PRESSURE (MB)
TT	=	TEMPERATURE (C)
Y	=	TOP OF POSITIVE AREA

SUBROUTINE TOTALS

CT	=	CROSS TOTALS
DDMP()	=	DEW POINT DEPRESSION (C) MANDATORY PRESSURE LEVELS
DPMP()	=	DEW POINT (C) MANDATORY PRESSURE LEVELS
KI	=	K-INDEX
KTT	=	K-INDEX PLUS TOTAL TOTALS
TMP()	=	TEMPERATURE (C) MANDATORY PRESSURE LEVEL
TOTALS	=	SUBROUTINE NAME
TT	=	TOTAL TOTALS
VT	=	VERTICAL TOTALS

SUBROUTINE POTEMP

CI	=	CONVECTIVE INSTABILITY
EQMP()	=	EQUIVALENT POTENTIAL TEMPERATURE MANDATORY PRES LEVELS

SUBROUTINE RESULT

AHIT0	=	HIT WHEN FORECASTING A RESULTA < .50
AHIT1	=	HIT WHEN FORECASTING A RESULTA > .499
ALI	=	LIFTED INDEX (NWS METHOD)
AMIS0	=	MISS WHEN FORECASTING A RESULTA < .50
AMIS1	=	MISS WHEN FORECASTING A RESULTA > .499
CB	=	CB TYPE CLOUD OBSERVED
CBPRE	=	CB TYPE CLOUD OBSERVED WITH ACCOMPANYING PRECIPITATION
CI	=	CONVECTIVE INSTABILITY
DDD()	=	DEW POINT DEPRESSION (C)
DDMP()	=	DEW POINT DEPRESSION (C) MANDATORY PRESSURE LEVELS
DPMP()	=	DEW POINT (C) MANDATORY PRESSURE LEVELS
EQN11	=	SUBROUTINE NAME
EQN16	=	SUBROUTINE NAME
EQN21	=	SUBROUTINE NAME

EQN27	=	SUBROUTINE NAME
EQN30	=	SUBROUTINE NAME
EQN31	=	SUBROUTINE NAME
EQN33	=	SUBROUTINE NAME
EQN34	=	SUBROUTINE NAME
EQN35	=	SUBROUTINE NAME
EQN36	=	SUBROUTINE NAME
EQN37	=	SUBROUTINE NAME
EQN41	=	SUBROUTINE NAME
EQN43	=	SUBROUTINE NAME
HIT0	=	HIT WHEN FORECASTING A RESULTM < .50
HIT1	=	HIT WHEN FORECASTING A RESULTM > .499
HTMP()	=	HEIGHT (M) MANDATORY PRESSURE LEVELS
IEQN	=	EQUATION NUMBER
IEQU	=	EQUATION NUMBER
IPROC	=	SOUNDINGS PROCESSED
ISKL	=	FIRST OR SECOND EQUATION USED
KI	=	K-INDEX
KTT	=	K-INDEX PLUS TOTAL TOTALS
MIS0	=	MISS WHEN FORECASTING A NON-OCCURRENCE
MIS1	=	MISS WHEN FORECASTING AN OCCURRENCE
PAJG	=	POSITIVE AREA (JOULES/GRAMS)
PLM()	=	PRESSURE (MB)
PRECI	=	OBSERVED PRECIPITATION
PW	=	PRECIPITABLE WATER
RESULT	=	SUBROUTINE NAME
RH4AV	=	AVERAGE RH (SFC-400MB)
RH5AV	=	AVERAGE RH (SFC-500MB)
RSLTA	=	RESULT USING THE AFTERNOON PARAMETERS
RSLTM	=	RESULT USING THE MORNING PARAMETERS
SKILLA	=	SUBROUTINE NAME
SKILLM	=	SUBROUTINE NAME
TC	=	CONVECTIVE (CRITICAL) TEMPERATURE
TCCL	=	TEMPERATURE AT CONVECTIVE CONDENSATION LEVEL
THK	=	THICKNESS (700MB - 850MB)
TMP()	=	TEMPERATURE (C) MANDATORY PRESSURE LEVEL
TOPOS	=	TOP OF POSITIVE AREA
TSPRE	=	THUNDERSTORM WITH PRECIPITATION OBSERVED
TSTM	=	TSTM OBSERVED
U()	=	U-COMPONENT
UBAR	=	AVERAGE U-COMPONENT OF WIND (SFC-850MB)
UI	=	UPPER LEVEL INSTABILITY INDEX
UII	=	UPPER LEVEL INSTABILITY INDEX (WHIT METHOD)
V()	=	V-COMPONENT
VBAR	=	AVERAGE V-COMPONENT OF WIND (SFC-850MB)
WDMP()	=	WIND DIRECTION, MANDATORY PRESSURE LEVELS
WI	=	LIFTED INDEX (WHIT'S METHOD)
WSMP()	=	WIND SPEED, (MANDATORY PRESSURE LEVELS)

SUBROUTINE EQUATION (ALL EQUATION SUBROUTINES)

ALI	=	LIFTED INDEX (NWS METHOD)
CI	=	CONVECTIVE INSTABILITY

DDMP()	=	DEW POINT DEPRESSION (C) MANDATORY PRESSURE LEVELS
DPMP()	=	DEW POINT (C) MANDATORY PRESSURE LEVELS
EQMP()	=	EQUIVALENT POTENTIAL TEMPERATURE MANDATORY PRES LEVELS
EQN11	=	SUBROUTINE NAME
EQN16	=	SUBROUTINE NAME
EQN21	=	SUBROUTINE NAME
EQN27	=	SUBROUTINE NAME
EQN30	=	SUBROUTINE NAME
EQN31	=	SUBROUTINE NAME
EQN33	=	SUBROUTINE NAME
EQN34	=	SUBROUTINE NAME
EQN35	=	SUBROUTINE NAME
EQN36	=	SUBROUTINE NAME
EQN37	=	SUBROUTINE NAME
EQN41	=	SUBROUTINE NAME
EQN43	=	SUBROUTINE NAME
HTMP()	=	HEIGHT (M) MANDATORY PRESSURE LEVELS
IEQN	=	EQUATION NUMBER
IEQU	=	EQUATION NUMBER
ISKL	=	FIRST OR SECOND EQUATION USED
KI	=	K-INDEX
KTT	=	K-INDEX PLUS TOTAL TOTALS
PAJG	=	POSITIVE AREA (JOULES/GRAMS)
PLM()	=	PRESSURE (MB)
PW	=	PRECIPITABLE WATER
RH4AV	=	AVERAGE RH (SFC-400MB)
RH5AV	=	AVERAGE RH (SFC-500MB)
RSLTA	=	RESULT USING THE AFTERNOON PARAMETERS
RSLTM	=	RESULT USING THE MORNING PARAMETERS
TC	=	CONVECTIVE (CRITICAL) TEMPERATURE
TCCL	=	TEMPERATURE AT CONVECTIVE CONDENSATION LEVEL
THK	=	THICKNESS (700MB - 850MB)
TMP()	=	TEMPERATURE (C) MANDATORY PRESSURE LEVEL
TOPOS	=	TOP OF POSITIVE AREA
TT	=	TOTAL TOTALS
U()	=	U-COMPONENT
UBAR	=	AVERAGE U-COMPONENT OF WIND (SFC-850MB)
UI	=	UPPER LEVEL INSTABILITY INDEX
V()	=	V-COMPONENT
VBAR	=	AVERAGE V-COMPONENT OF WIND (SFC-850MB)
WDMP()	=	WIND DIRECTION (DEG) MANDATORY PRESSURE LEVELS
WI	=	LIFTED INDEX (WHIT'S METHOD)
WSMP()	=	WIND SPEED (KTS) MANDATORY PRESSURE LEVELS

SUBROUTINE SKILLM

CBPRE	=	CB TYPE CLOUD OBSERVED WITH ACCOMPANYING PRECIPITATION
COR	=	PERCENT CORRECT (DECIMAL)
CORR	=	PERCENT CORRECT
DD	=	INCREMENTERS
HIT0	=	HIT WHEN FORECASTING A RESULTM < .50
HIT1	=	HIT WHEN FORECASTING A RESULTM > .499
IEQU	=	EQUATION NUMBER

IHR	=	HOUR OR RADIOSONDE RELEASE
IMISS	=	UNPROCESSED SOUNDINGS DUE TO BAD DATA
IMON	=	MONTH INDICATOR
IPROC	=	SOUNDINGS PROCESSED
ISOND	=	NUMBER OF RADIOSONDES PROCESSED
IYR	=	RADIOSONDE RELEASE YEAR
MDAYS	=	SOUNDINGS NOT PROCESSED
MIS0	=	MISS WHEN FORECASTING A NON-OCCURRENCE
MIS1	=	MISS WHEN FORECASTING AN OCCURRENCE
ML	=	MISSING OR BAD DATA AT LEVEL
MON()	=	MONTH OF THE YEAR
RSLTM	=	RESULT USING THE MORNING PARAMETERS
SITE	=	LOCATION OF RAWINSONDE RELEASE
SKILLM	=	SUBROUTINE NAME
SS	=	SKILL SCORE
TFN	=	TOTAL FORECASTS, NO
TFY	=	TOTAL FORECASTS, YES
THIT	=	TOTAL HITS, OCCURRENCES AND NON-OCCURRENCES
THIT0	=	TOTAL HITS, NON-OCCURRENCE
THIT1	=	TOTAL HITS, OCCURRENCE
TMIS	=	TOTAL MISSES, OCCURRENCES AND NON-OCCURRENCE
TMIS0	=	TOTAL MISSES, NON-OCCURRENCE
TMIS1	=	TOTAL MISSES, OCCURRENCE
TON	=	TOTAL OBSERVED, NO
TOY	=	TOTAL OBSERVED YES
TYN	=	COMBINED TOTAL (FORECAST AND OBSERVED)
T1	=	TOTAL OBSERVED (SKILLM,SKILLA)
T2	=	TOTAL FORECASTED (SKILLM,SKILLA)

SUBROUTINE SKILLA

AHIT0	=	HIT WHEN FORECASTING A RESULTA < .50
AHIT1	=	HIT WHEN FORECASTING A RESULTA > .499
AMIS0	=	MISS WHEN FORECASTING A RESULTA < .50
AMIS1	=	MISS WHEN FORECASTING A RESULTA > .499
CBPRE	=	CB TYPE CLOUD OBSERVED WITH ACCOMPANYING PRECIPITATION
COR	=	PERCENT CORRECT (DECIMAL)
CORR	=	PERCENT CORRECT
DD	=	
IEQN	=	EQUATION NUMBER
IHR	=	HOUR OR RADIOSONDE RELEASE
IMISS	=	UNPROCESSED SOUNDINGS DUE TO BAD DATA
IMON	=	MONTH INDICATOR
IPROC	=	SOUNDINGS PROCESSED
ISOND	=	NUMBER OF RADIOSONDES PROCESSED
IYR	=	RADIOSONDE RELEASE YEAR
MDAYS	=	SOUNDINGS NOT PROCESSED
MON	=	MONTH OF THE YEAR
RSLTA	=	RESULT USING THE AFTERNOON PARAMETERS
SITE	=	LOCATION OF RAWINSONDE RELEASE
SKILLA	=	SUBROUTINE NAME
SS	=	SKILL SCORE
TFN	=	TOTAL FORECASTS, NO

TFY	=	TOTAL FORECASTS, YES
THIT	=	TOTAL HITS, OCCURRENCES AND NON-OCCURRENCES
THITO	=	TOTAL HITS, NON-OCCURRENCE
THIT1	=	TOTAL HITS, OCCURRENCE
TMIS	=	TOTAL MISSES, OCCURRENCES AND NON-OCCURRENCE
TMISO	=	TOTAL MISSES, NON-OCCURRENCE
TMIS1	=	TOTAL MISSES, OCCURRENCE
TON	=	TOTAL OBSERVED, NO
TOY	=	TOTAL OBSERVED YES
TYN	=	COMBINED TOTAL (FORECAST AND OBSERVED)
T1	=	TOTAL OBSERVED (SKILLM,SKILLA)
T2	=	TOTAL FORECASTED (SKILLM,SKILLA)

```
      PROGRAM PRE
      *** MANUAL INPUT IS REQUIRED TO RUN THIS PROGRAM
      CHARACTER*9 FILN,FILEN,DATES
      CHARACTER*8 TIMS
      CHARACTER*4 SITE
      COMMON /TIMES/ ISOND,IYR,IHR,MDAYS,IPROC,IMON
      COMMON /CHARA/ FILN,SITE,FILEN,DATES,TIMS
      CALL DATE(DATES) ! GET CURRENT DATE
      CALL TIME(TIMS)  ! GET CURRENT TIME
      MDAYS = 0
      IPROC = 0
      WRITE(6,*)'ENTER RAWINSONDE STATION'
      READ(6,10) SITE
 1010 FORMAT(A4)
      CALL READS
      STOP
      END
      BLOCK DATA CMN
      REAL MR,KI,KTT,MIS0,MIS1
      INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
      CHARACTER*9 FILN,FILEN,DATES
      CHARACTER*8 TIMS
      CHARACTER*4 SITE
      COMMON /READ1/ PPL(100),TTE(100),TTD(100),DDD(100),HHT(100),
     +WD(100),WS(100)
      COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
     +HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
      COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
     +PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HIT0,MIS0,CI,ALI,UI,
     +RSLTA,AHIT1,AMIS1,AHIT0,AMIS0,PAJG,TOPOS,TC,PCCL,TCCL,UII
      COMMON /COMP1/ RH(100),MR(100),EPT(100)
      COMMON /TIMES/ ISOND,IYR,IHR,MDAYS,IPROC,IMON
      COMMON /CHARA/ FILN,SITE,FILEN,DATES,TIMS
      COMMON /MISC/ ISIG,IEQU,IEQN,IMISS
      END
      SUBROUTINE READS
      CHARACTER*9 FILN,FILEN,DATES
      CHARACTER*8 TIMS
      CHARACTER*4 SITE
      COMMON /TIMES/ ISOND,IYR,IHR,MDAYS,IPROC,IMON
      COMMON /CHARA/ FILN,SITE,FILEN,DATES,TIMS
      WRITE(6,*)'ENTER NUMBER OF SOUNDINGS'
      READ(6,*) ISOND
      WRITE(6,*) 'ENTER OUTPUT FILE NAME'
      READ (6,20) FILEN
   20 FORMAT(A9)
      WRITE(6,*) 'ENTER INPUT FILE NAME'
      READ(6,20) FILN
      OPEN(UNIT=7,FILE=FILN,STATUS='OLD',IOSTAT=IOS)  ! OPEN INPUT FILE
      IF(IOS.GT.0) THEN
        WRITE(6,50) FILN,IOS
   50     FORMAT(2X,'ERROR OPENING FILE: ',A9,4X,'IOSTAT= ',I4,
     +    ' PROGRAM WILL NOW STOP')
```

```
        CALL EXIT
      ENDIF
      CALL READF
      RETURN
      END
      SUBROUTINE READF
      INTEGER CB,PRECI,CBPRE,TSPRE,TSTM
      REAL KI,KTT,MISO,MIS1,MR
      CHARACTER*9 FILN,FILEN,DATES
      CHARACTER*8 TIMS
      CHARACTER*4 TYPE
      CHARACTER*4 SITE
      COMMON /READ1/ PPL(100),TTE(100),TTD(100),DDD(100),HHT(100),
     +WD(100),WS(100)
      COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
     +PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HITO,MISO,CI,ALI,UI,
     +RSLTA,AHIT1,AMIS1,AHITO,AMISO,PAJG,TOPOS,TC,PCCL,TCCL,UII
      COMMON /COMP1/ RH(100),MR(100),EPT(100)
      COMMON /TIMES/ ISOND,IYR,IHR,MDAYS,IPROC,IMON
      COMMON /CHARA/ FILN,SITE,FILEN,DATES,TIMS
      COMMON /MISC/ ISIG,IEQU,IEQN,IMISS
   10 ISIG = 0                        ! SIG LEVELS     = 0
      ML   = 0                        ! MISSING LEVELS = 0
      *** THIS SECTION READS THE FILE WHERE RAW RAWINSONDE DATA (FOR SALT
      *** LAKE CITY, UT) IS HELD.  WE OBTAINED THESE DATA AT A MINIMAL COST
      *** FROM THE NATIONAL CENTER FOR ATMOSPHERIC RESEARCH (NCAR).
      READ(UNIT=7,FMT=20,IOSTAT=IOS,ERR=70)TYPE,ISTA,IYR,IMON,ID,
     +IHR,CB,PRECI,CBPRE,TSTM,TSPRE
   20 FORMAT(1X,A4,I7,4I6,5I2)
      IF(ISTA.EQ.24127) THEN
        ISTA = 72572                   ! SALT LAKE CITY = 72572
      ELSE
        WRITE(6,*)'INCORRECT STATION NUMBER'
      ENDIF
      DO 1000 I = 1,100    ! READ IN DATA
         READ(UNIT=7,FMT=30,IOSTAT=IOS,ERR=70)PPL(I),HHT(I),
     +   TTE(I),RH(I),WD(I),WS(I)
   30    FORMAT(F4.0,F6.0,F6.1,3F4.0)
         IF(PPL(I).LT.200..OR.PPL(I).GT.1050.) GO TO 50
         WS(I) = WS(I) * 1.94254      ! MPS TO KNOTS
         *** IF WINDS ARE MISSING ABOVE 500MB OR RELATIVE HUMIDITY IS
         *** MISSING FOR TEMPERATURES LESS THAN -40 DEGREES (C) SET
         *** RELATIVE HUMIDITY TO 19 PERCENT AND CONTINUE TO PROCESS
         *** THESE DATA
         IF(PPL(I).GT.1050. .OR. TTE(I).EQ.99. .OR. HHT(I).EQ.64000.)
     +   GO TO 40
         IF(WD(I).GT.360. .AND. PPL(I).EQ.PPL(1)) GO TO 40
         IF(WD(I).GT.360. .AND. PPL(I).EQ.850.)   GO TO 40
         IF(WD(I).GT.360. .AND. PPL(I).EQ.700.)   GO TO 40
         IF(WD(I).GT.360. .AND. PPL(I).EQ.500.)   GO TO 40
         IF(WS(I).GT.250. .AND. PPL(I).EQ.PPL(1)) GO TO 40
         IF(WS(I).GT.250. .AND. PPL(I).EQ.850.)   GO TO 40
         IF(WS(I).GT.250. .AND. PPL(I).EQ.700.)   GO TO 40
```

```
      IF(WS(I).GT.250. .AND. PPL(I).EQ.500.)   GO TO 40
      IF(RH(I).EQ.990. .AND. TTE(I).GT.-40.) THEN
 40     WRITE(6,*)'ERR',PPL(I),HHT(I),TTE(I),WD(I),WS(I),RH(I)
        ML = ML + 1                 ! MISSING LEVELS
        GO TO 1000
      ENDIF
      IF(RH(I).EQ.990.) THEN    ! SET RH TO 19 %
        RH(I) = 19.
      ENDIF
      ISIG = ISIG + 1
1000 CONTINUE
 50 IF(ML.GE.1) THEN
     MDAYS = MDAYS + 1
     WRITE(6,60) MDAYS
 60  FORMAT(6X,I2,'DAY(S) NOT PROCESSED, MISSING DATA')
     IF((MDAYS+IPROC).GE.ISOND) THEN  ! IS THIS THE LAST RADIOSONDE ?
       CLOSE(UNIT=7,STATUS='KEEP')
       CLOSE(UNIT=4,STATUS='KEEP')
       IMISS = 1            ! LAST DAY A BAD ONE. CALL SKILL,
       CALL SKILLM(IEQU)    ! DO CONTINGENCY TABLE
       CALL SKILLA(IEQN)
       CALL EXIT            ! AND QUIT
     ELSE
       GO TO 10             ! GO READ NEXT LEVEL
     ENDIF
    ELSE
     CALL CALCU             ! GO ON AND DO CALCULATIONS
    ENDIF
 70 WRITE(6,80) FILN,IOS
 80 FORMAT(2X,'ERROR READING FILE: ',A9,' IOSTAT = ',I4)
    RETURN
    END
    SUBROUTINE CALCU
    REAL MR,LHC
    COMMON /READ1/ PPL(100),TTE(100),TTD(100),DDD(100),HHT(100),
   +WD(100),WS(100)
    COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
   +HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
    COMMON /COMP1/ RH(100),MR(100),EPT(100)
    COMMON /TIMES/ ISOND,IYR,IHR,MDAYS,IPROC
    COMMON /MISC/ ISIG,IEQU,IEQN,IMISS
    DATA A0,A1,A2 /797.30435,-0.8703517,0.000508/
    DATA PLM/000.0,850.0,700.0,500.0,400.0,300.0,250.0,200.0,
   +150.0,100.0/
    IPROC = IPROC + 1       ! GOOD RAWINSONDES, NO BAD DATA
    DO 1000 I = 1,ISIG
      TEK    = 273.16+TTE(I)
      TED    = 273.16 + TTD(I)
      SVP    = 6.1121*EXP(17.67*TTD(I)/(TTD(I)+243.5))
      VP     = 6.1121*EXP(17.67*TTE(I)/(TTE(I)+243.5))
      X      = 1. - 0.01*RH(I)
      DDD(I) = (14.55+0.114*TTE(I))*X+((2.5+0.007*TTE(I))
   +           *X)**3.+(15.9+0.117*TTE(I))*X**14.
```

```
         TTD(I) = TTE(I) - DDD(I)
         ES     = 6.105*EXP(25.22*(TTD(I)/TED)-5.31
     +            *ALOG(TED/273.16))
         MR(I)  = (0.622*ES/(PPL(I)-ES))
         LHC    = A0 + A1 * TEK + A2 * TEK * TEK
         TAE    = TEK * EXP((LHC * MR(I))/(.24 * TEK))
         EPT(I) = TAE * (1000./PPL(I))**0.286
 1000 CONTINUE
      *** SET UP MANDATORY PRESSURE LEVEL DATA
   10 II = 2
      IC = 1
      IN = 2
      *** MATCH THE DATA FOR DISPLAY OF MANDATORY PRESSURE LEVEL DATA.
      *** INCLUDE SURFACE DATA WITH THE MANDATORY PRESSURE LEVELS.
      PLM(1)  = PPL(1)
      TMP(1)  = TTE(1)
      DPMP(1) = TTD(1)
      DDMP(1) = DDD(1)
      RHMP(1) = RH(1)
      HTMP(1) = HHT(1)
      EQMP(1) = EPT(1)
      WDMP(1) = WD(1)
      WSMP(1) = WS(1)
      *** CHECK TO SEE IF FIRST MANDATORY PRESSURE LEVEL WILL BE
      *** 1000, 850 OR 700 MB
      IF(PPL(1).LE.PLM(2)) THEN
         PLM(2)   = PPL(1)
         TMP(2)   = TTE(1)
         DPMP(2)  = TTD(1)
         DDMP(2)  = DDD(1)
         RHMP(2)  = RH(1)
         HTMP(2)  = HHT(1)
         EQMP(2)  = EPT(1)
         WDMP(2)  = WD(1)
         WSMP(2)  = WS(1)
         IC = 3
         II = 3
         IN = 3
      ENDIF
      DO 1100 I = IN,ISIG
         IF(PPL(I).NE.PLM(II)) GO TO 1100
         TMP(II)  = TTE(I)
         DPMP(II) = TTD(I)
         DDMP(II) = DDD(I)
         RHMP(II) = RH(I)
         HTMP(II) = HHT(I)
         EQMP(II) = EPT(I)
         WDMP(II) = WD(I)
         WSMP(II) = WS(I)
         II = II + 1
 1100 CONTINUE
      *** CALL SEVERE WEATHER SUBROUTINE TO DO MOST OR THE
      *** CALCULATIONS THIS PROGRAM NEEDS
```

```
      CALL SVRWX
      RETURN
      END
      SUBROUTINE SVRWX
      *** THIS SUBROUTINE CALCULATES OR CALLS SUBPROGRAMS TO
      *** CALCULATE THE REQUIRED SEVERE WEATHER INDICES.
      INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
      REAL MR,KI,KTT,MISO,MIS1
      CHARACTER*9 FILN,FILEN,DATES
      CHARACTER*8 TIMS
      CHARACTER*4 SITE
      CHARACTER*1 IPM,YES
      COMMON /READ1/ PPL(100),TTE(100),TTD(100),DDD(100),HHT(100),
     +WD(100),WS(100)
      COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
     +HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
      COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
     +PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HITO,MISO,CI,ALI,UI,
     +RSLTA,AHIT1,AMIS1,AHITO,AMISO,PAJG,TOPOS,TC,PCCL,TCCL,UII
      COMMON /COMP1/ RH(100),MR(100),EPT(100)
      COMMON /TIMES/ ISOND,IYR,IHR,MDAYS,IPROC,IMON
      COMMON /CHARA/ FILN,SITE,FILEN,DATES,TIMS
      DATA YES/'Y'/
      WRITE(6,10) IPROC
   10 FORMAT('1',5X,'SEVERE WEATHER INDICE DAYS = ',I4)
      *** COMPUTE MEAN RELATIVE HUMIDITY AND PRECIPITABLE WATER
      *** USING SPECIFIC HUMIDITY AND PRESSURE THROUGH THE LAYER
      *** (SFC-500MB).
      CALL PWRH
      *** COMPUTE MEAN RELATIVE HUMIDITY AND PRECIPITABLE WATER
      *** USING SPECIFIC HUMIDITY AND PRESSURE THROUGH THE LAYER
      *** (SFC-400MB).
      CALL PWRH4
      *** COMPUTE THICKNESS (METERS) BETWEEN 700MB AND 850MB LEVELS.
      THK = HTMP(3) - HTMP(2)
      *** COMPUTE " U " AND " V " COMPONENTS OF THE WIND USING
      *** MANDATORY PRESSURE LEVEL DATA TO 500MB.
      *** WE MUST CHANGE DEGREES TO RADIANS BEFORE FINDING
      *** "U" AND "V".
      CALL WIND
      *** COMPUTE THE TEMPERATURE AND PRESSURE AT THE LIFTED
      *** CONDENSATION LEVEL (LCL) GIVEN SURFACE TEMPERATURE AND
      *** DEW POINT.
      CALL SHLCL
      *** COMPUTE THE TEMPERATURE AND PRESSURE AT THE LIFTED
      *** CONDENSATION LEVEL (LCL) NATIONAL WEATHER SERVICE (NWS)
      *** METHOD.
      CALL LILCL
      *** COMPUTE UPPER LEVEL STABILITY INDEX.  TAKEN FROM WESTERN
      *** REGION TECHNICAL ATTACHMENT NO.  84-15 MAY 22,1984
      CALL ULCL
      *** HERE WE CALCULATE A DIFFERENT LCL WHICH ALLOWS US TO
      *** CALCULATE A CONVECTIVE CONDENSATION LEVEL (CCL) AND THE
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      *** POSITIVE AREA OF A SOUNDING.
      CALL AREAP(PCCL,TCCL,TC,PAJG,TOPOS)
      *** COMPUTE THE CROSS TOTALS(CT), VERTICAL TOTALS(VT), AND
      *** TOTAL TOTALS (TT).
      *** WE USE 700 AND 500 MILLIBAR DATA INSTEAD OF THE USUAL
      *** 850-500 MILLIBAR LEVELS.
      CALL TOTALS
      *** COMPUTE CONVECTIVE INSTABILITY (CI) USING THE EQUIVALENT
      *** POTENTIAL TEMPERATURE (THETA).
      CALL POTEMP
      *** HERE WE USE THE DATA WHICH THE REGRESSION MODEL PICKED AS
      *** THE MOST SIGNIFICANT PARAMETERS TO GET THE "RESULT'.
      CALL RESULT
      *** IS THIS THE LAST RADIOSONDE TO BE PROCESSED ?
      IF((IPROC+MDAYS).NE.ISOND) THEN
        CALL READF            ! NOT THE LAST ONE, GO DO NEXT ONE
      ENDIF
      WRITE(6,20)MDAYS
   20 FORMAT(2X,'TOTAL SOUNDINGS NOT PROCESSED: ',I4)
      WRITE(6,*)' WANT TO PROCESS ANOTHER SERIES OF SOUNDINGS ?? (Y/N)'
      READ(6,30)IPM
   30 FORMAT(A1)
      WRITE(6,40)IPM
   40 FORMAT(A1)
      IF(IPM.EQ.YES) THEN     ! READ A NEW FILE ??
        MDAYS = 0
        IPROC = 0
        CALL READS            ! GO READ NEW FILE
      ELSE
        CLOSE(UNIT=7,STATUS='KEEP')
        CLOSE(UNIT=4,STATUS='KEEP')
      ENDIF
      STOP
      END
      SUBROUTINE PWRH
      *** THIS SUBROUTINE CALCULATES PRECIPITABLE WATER AND MEAN
      *** RELATIVE HUMIDITY.
      INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
      REAL MR,MRAVG,KI,KTT,MIS0,MIS1
      COMMON /READ1/ PPL(100),TTE(100),TTD(100),DDD(100),HHT(100),
     +WD(100),WS(100)
      COMMON /COMP1/ RH(100),MR(100),EPT(100)
      COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
     +PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HIT0,MIS0,CI,ALI,UI,
     +RSLTA,AHIT1,AMIS1,AHIT0,AMIS0,PAJG,TOPOS,TC,PCCL,TCCL,UII
      COMMON /MISC/ ISIG,IEQU,IEQN,IMISS
      *** INITIALIZE VARIABLES
      PWS   = 0.0
      RHSM  = 0.0
      PD    = 0.0
      *** COMPUTE PRECIPITABLE WATER USING SPECIFIC HUMIDITY AND
      *** PRESSURE.  COMPUTE MEAN RELATIVE HUMIDITY THROUGH THE
      *** LAYER (SFC-500MB)
```

```
  DO 1000 J = 2,ISIG
        IF(PPL(J).LT.500.) GO TO 10
        MRAVG =  (MR(J-1) + MR(J)) * 0.5
        DELTP =  PPL(J-1) - PPL(J)
        PD    =  PD + DELTP
        PWS   =  PWS + (MRAVG * DELTP)
        RHAVG =  (RH(J-1) + RH(J))/2.
        RHSM  =  RHSM + (RHAVG * DELTP)
0 CONTINUE
0 RH5AV = RHSM/PD
  PW  = ((1000./980.)*PWS)/2.54
  RETURN
  END
  SUBROUTINE PWRH4
  *** THIS SUBROUTINE CALCULATES PRECIPITABLE WATER AND MEAN
  *** RELATIVE HUMIDITY BETWEEN THE SURFACE AND 400 MILLIBARS.
  INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
  REAL MR,MRAVG,KI,KTT,MIS0,MIS1
  COMMON /READ1/ PPL(100),TTE(100),TTD(100),DDD(100),HHT(100),
 +WD(100),WS(100)
  COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
 +HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
  COMMON /COMP1/ RH(100),MR(100),EPT(100)
  COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
 +PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HIT0,MIS0,CI,ALI,UI,
 +RSLTA,AHIT1,AMIS1,AHIT0,AMIS0,PAJG,TOPOS,TC,PCCL,TCCL,UII
  COMMON /MISC/ ISIG,IEQU,IEQN,IMISS
  *** INITIALIZE VARIABLES
  H20      = 0.0
  SMRH     = 0.0
  DPRES    = 0.0
  *** COMPUTE PRECIPITABLE WATER USING SPECIFIC HUMIDITY AND
  *** PRESSURE.  COMPUTE MEAN RELATIVE HUMIDITY THROUGH THE
  *** LAYER (SFC-400MB)
  DO 1000 J = 2,ISIG
     IF(PPL(J).LT.400.) GO TO 10
     MRAVG    =  (MR(J-1) + MR(J)) * 0.5
     DELTP    =  PPL(J-1) - PPL(J)
     DPRES    =  DPRES + DELTP
     H20      =  H20 + (MRAVG * DELTP)
     RHAVG    =  (RH(J-1) + RH(J))/2.
     SMRH     =  SMRH + (RHAVG * DELTP)
00 CONTINUE
10 RH4AV = SMRH/DPRES
  WP    = ((1000./980.)*H20)/2.54
  RETURN
  END
  SUBROUTINE WIND
  *** COMPUTE " U " AND " V " COMPONENTS OF THE WIND.
  *** WE MUST CHANGE DEGREES TO RADIANS BEFORE FINDING
  *** "U" AND "V".
  INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
  REAL KI,KTT,MIS0,MIS1
```

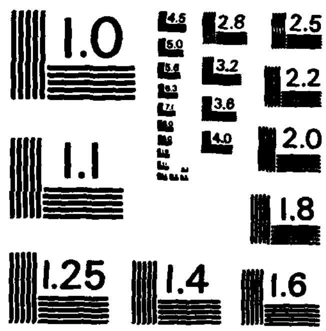
AD-A159 275   A CUMULONIMBUS AND THUNDERSTORM STEPWISE MULTIPLE REGRESSION OBJECTIVE FORECAST STUDY FOR SALT LAKE CITY (U) ARMY DUGWAY PROVING GROUND UT A W WALDRON AUG 85   4/4

UNCLASSIFIED   DPG-FR-85-013   F/G 4/2   NL

END

FILMED

DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

```
      PARAMETER (DTOR=57.29578)
      COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
     +HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
      COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
     +PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HIT0,MIS0,CI,ALI,UI,
     +RSLTA,AHIT1,AMIS1,AHIT0,AMIS0,PAJG,TOPOS,TC,PCCL,TCCL,UII
      *** WHEN PROCESSING PARTIALLY PROCESSED DATA COMPARED TO RAW
      *** DATA CHANGE THE " DO LOOP TO 1,2 vs 1,4.
      DO 1000 L = 1,4
         ANG  =  (270.-WDMP(L))/DTOR
         U(L) =  WSMP(L)*COS(ANG)
         V(L) =  WSMP(L)*SIN(ANG)
 1000 CONTINUE
      UBAR = (U(1)+U(2))/2.
      VBAR = (V(1)+V(2))/2.
      RETURN
      END
      SUBROUTINE SHLCL
      INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
      REAL KI,KTT,MIS0,MIS1
      COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
     +HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
      COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
     +PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HIT0,MIS0,CI,ALI,UI,
     +RSLTA,AHIT1,AMIS1,AHIT0,AMIS0,PAJG,TOPOS,TC,PCCL,TCCL,UII
      FP(TL) = TL**.2857
      FO(Y)  = 3139.114/Y - 2.343
      FE(X)  = 6.11 * X**5.31 * EXP(25.22 * (1. - X))
      *** COMPUTE TEMPERATURE AT LIFTED CONDENSATION LEVEL (LCL)
      T    =  TMP(1) + 273.16
      D    =  DPMP(1) + 273.16
      A    =  1./(D - 56.)
      B    =  ALOG(T/D)/800.
      TC   =  1./(A+B)+56.
      TLL  =  TC - 273.16
      *** COMPUTE PRESSURE AT THE LCL GIVEN SURFACE PRESSURE,
      *** TEMPERATURE AND TEMPERATURE AT THE LCL.
      PLL  =  PLM(1)*(TC/T)**3.5037
      *** COMPUTE LIFTED INDEX
      THETA = T*FP(1000./PLM(1))
      IF(T.LE.320. .OR. D.LE.320.) THEN
        TLCL = D-(0.001296*D-0.15772)*(T-D)
        PLCL = 1000.*(TLCL/THETA)**3.496
        T    = THETA/FP(2.)
        IF(PLCL.LT.500.) RETURN
        CALL LIFT(PLCL,TLCL,500.,T)
        WI   = TMP(4) - (T-273.16)
      ENDIF
      RETURN
      END
      SUBROUTINE LILCL
      *** THIS SUBROUTINE COMPUTES THE TEMPERATURE AND PRESSURE
      *** AT THE LIFTED CONDENSATION LEVEL (LCL), USING THE SAME
```

```
      *** METHOD AS THEY USE AT THE NATIONAL WEATHER SERVICE IN
      *** SALT LAKE CITY.
      REAL KI,KTT,MISO,MIS1
      INTEGER CB,CBPRE,PRECI,TSTM,TSPRE
      DIMENSION XT(10),ZD(10)
      COMMON /READ1/ PPL(100),TTE(100),TTD(100),DDD(100),HHT(100),
     +WD(100),WS(100)
      COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
     +PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HITO,MISO,CI,ALI,UI,
     +RSLTA,AHIT1,AMIS1,AHITO,AMISO,PAJG,TOPOS,TC,PCCL,TCCL,UII
      FP(TL) = TL**0.2857
      N1 = 30
      AP = 850.
      APO = 150.
      IW = 1
      IF(AP.LE.PPL(1)) GO TO 10
      AP = 800.
      IF(AP.GT.PPL(1)) RETURN
      IFLG = 1
      APO = 100.
   10 I = 1
   20 I = I + 1
      IF(PPL(I).LE.AP) GO TO 40
   30 IF(I.EQ.N1) RETURN
      GO TO 20
   40 PI = FP(PPL(I))
      SL = (FP(AP)-PI)/(PI-FP(PPL(I-1)))
      XT(IW) = SL*(TTE(I) - TTE(I-1)) + TTE(I)
      ZD(IW) = SL*(TTD(I) - TTD(I-1)) + TTD(I)
      IW = IW + 1
      IF(IW.GT.3) GO TO 50
      AP = AP - APO
      APO = 200.
      GO TO 30
   50 T = XT(1) + 273.16
      D = ZD(1) + 273.16
      APO = 850.
      IF(IFLG.EQ.1) APO = 800.
      THETA = T*FP(1000./APO)
      IW = 1
   60 IF(T.GT.320. .OR. D.GT.320.) RETURN
      TLCL = D-(0.001296*D-0.15772)*(T-D)
      PLCL = 1000.*(TLCL/THETA)**3.496
      T = THETA/FP(2.)
      IF(PLCL.LT.500.) GO TO 70
      *** COMPUTE LIFTED INDEX
      CALL LIFT(PLCL,TLCL,500.,T)
      ALI = XT(3) - (T-273.16)
   70 IF(IW.EQ.1) CALL MMXRT(D,TD1,T)
      THETA = T * FP(1000./PPL(1))
      IW = IW + 1
      IF(IW.EQ.2) GO TO 60
      RETURN
```

```
 END
 SUBROUTINE ULCL
 INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
 REAL KI,KTT,MISO,MIS1
 COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
+HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
 COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
+PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HITO,MISO,CI,ALI,UI,
+RSLTA,AHIT1,AMIS1,AHITO,AMISO,PAJG,TOPOS,TC,PCCL,TCCL,UII
 FP(TL) = TL**.2857
 FO(Y)  = 3139.114/Y - 2.343
 FE(X)  = 6.11 * X**5.31 * EXP(25.22 * (1. - X))
 *** COMPUTE TEMPERATURE AT LIFTED CONDENSATION LEVEL (LCL)
 T    =  TMP(4) + 273.16
 D    =  DPMP(4) + 273.16
 A    =  1./(D - 56.)
 B    =  ALOG(T/D)/800.
 TC   =  1./(A+B)+56.
 TLL  =  TC - 273.16
 *** COMPUTE PRESSURE AT THE LCL GIVEN SURFACE PRESSURE, TEMPERATURE
 *** AND TEMPERATURE AT THE LCL.
 PLL  =  PLM(4)*(TC/T)**3.5037
 *** COMPUTE LIFTED INDEX (500MB TO 300MB)
 T500 = TMP(4) + 273.16
 THETA = T*FP(1000./PLM(4))
 IF(T.LE.320. .OR. D.LE.320.) THEN
   TLCL = D-(0.001296*D-0.15772)*(T-D)
   PLCL = 1000.*(TLCL/THETA)**3.496
   T    = THETA/FP(2.)
   TN = T
   IF(PLCL.LT.300.) THEN
     T300 = T500 * (300./500.)**0.2857143
     T400 = T500 * (400./500.)**0.2857143
   ELSEIF(PLCL.LT.400..AND.PLCL.GT.300.) THEN
     T400 = T500 * (400./500.)**0.2857143
     CALL LIFT(PLCL,TLCL,300.,T)
     T300 = T
   ELSE
     CALL LIFT(PLCL,TLCL,400.,TN)
     T400 = TN
     CALL LIFT(PLCL,TLCL,300.,T)
     T300 = T
   ENDIF
   T300 = T300 - 273.16
   T400 = T400 - 273.16
   UI   = (TMP(5) - T400)+(TMP(6)-T300)
 ENDIF
 RETURN
 END
 SUBROUTINE LIFT(PI,TI,ALPF,T)
 *** COMPUTE LIFTED INDEX (NWS METHOD).
 PARAMETER(CPW=1.841,EP=0.62197,C=4.184)
 PARAMETER(CP=1.005,R=0.28704)
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```
      FE(X) = 6.11 * X**5.31 * EXP(25.22 * (1. - X))
      FO(Y) = 3139.114/Y - 2.343
      T = TI
      P = PI
   10 E  = FE(273.16/T)
      TW = EP*E/(P-E)
      SP = CP+TW*C
      S  = SP*ALOG(T)-R*ALOG(P-E)+TW*FO(T)
      P  = P - 5.
      IF(P.LT.ALPF) P = ALPF
   20 E  = FE(273.16/T)
      W  = EP*E/(P-E)
      PL = FO(T)
      SK = SP*ALOG(T)-R*ALOG(P-E)+W*PL
      OS = (SP-W*((C-CPW)-(EP+W)*PL*PL/R))/T
      T  = T+(S-SK)/OS
      IF(S-SK.GT.1.E-7) GO TO 20
      IF(P.NE.ALPF) GO TO 10
      RETURN
      END
      SUBROUTINE MMXRT(TD,TD1,T)
      *** COMPUTE MIXING RATIO FOR LITED INDEX (NWS METHOD).
      COMMON /READ1/ PPL(100),TTE(100),TTD(100),DDD(100),HHT(100),
     +WD(100),WS(100)
      COMMON /MISC/ ISIG,IEQU,IEQN,IMISS
      FE(X) = 6.11 * X**5.31 * EXP(25.22 * (1. - X))
      P50 = PPL(1)-50.
      DO 1100 I = 2,ISIG
         NN = I
         IF(PPL(I).LE.P50)  GO TO 10
 1100    CONTINUE
   10 T50 = (50./(PPL(1) - PPL(NN))) * (TTE(NN) - TTE(1)) + TTE(1)
      D50 = (50./(PPL(1) - PPL(NN))) * (TTD(NN) - TTD(1)) + TTD(1)
      TD  = 273.16/((TTD(1) + D50)/2. + 273.16)
      EB  = FE(TD)
      XMB = 0.62197*EB/((PPL(1) + P50)/2. - EB)
      T   = ((TTE(1)+ T50)/2.) + 273.16
      EC  = PPL(1)/(1. + 0.62197/XMB)
      TD  = 1./(0.003661 - (0.0001844 * ALOG(EC/6.11)))
      EJC = (PPL(1) - 300.)/(1. + 0.62197/XMB)
      TD1 = 1./(0.003661 - (0.0001844 * ALOG(EJC/6.11)))
      RETURN
      END
      SUBROUTINE AREAP(P2,T2,TC1,A1,Y)
      *** COMPUTE "POSITIVE AREA" OF A SOUNDING
      COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
     +HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
      A = PLM(1)
      B = TMP(1)
      C = DPMP(2)
      D = TMP(2)
      E = TMP(3)
      F = TMP(4)
```

```
      G = TMP(6)
      H = TMP(8)
      *** SATURATION VAPOR PRESSURE AT 850 MB
      E1 = 6.11*(10.**(7.567*C/(239.7+C)))
      *** SATURATION MIXING RATIO AT 850 MB
      W = 0.622*E1/850.
      *** SATURATION VAPOR PRESSURE AT SURFACE
      E2 = W*A/0.622
      *** SURFACE DEW POINT
      T3 = (ALOG10(E2/6.11))*239.7/(7.567 - ALOG10(E2/6.11))
      *** DEW POINT DEPRESSION
      D1 = B - T3
      IF(B - T3) 10,10,20   ! REDO DEW POINT IF > T
   10 T3 = B - 1.
      D1 = 1.
      *** COMPUTE ACTUAL LAPSE RATES
   20 Z = (H - G)/100.   ! LAPSE RATE 300 - 200MB
      Z1 = (G - F)/200.  ! LAPSE RATE 500 - 300MB
      Z2 = (F - E)/200.  ! LAPSE RATE 700 - 500MB
      Z3 = (E - D)/150.  ! LAPSE RATE 850 - 700MB
      Z4 = (D - B)/(A - 850.)   ! LAPSE RATE SURFACE - 850MB
      *** CALL SUBROUTINE LCLCCL TO DETERMINE TEMPERATURE AND
      *** PRESSURE AT LIFTING CONDENSATION LEVEL (LCL) AND
      *** CONVECTIVE CONDENSATION LEVEL (CCL).
      CALL LCLCCL(T3,D1,A,B,Z4,D,Z3,E,Z2,F,Z1,G,T1,P1,BB,T,P)
      P2 = P      ! REASSIGN CCL PRESSURE
      T2 = T      ! REASSIGN CCL TEMPERATURE
      TC1 = BB - 1.   ! CONVECTIVE TEMPERATURE (C)
      *** CALL SUBROUTINE PAREA TO DETERMINE POSITIVE AREA
      CALL PAREA(T,P,Z3,Z2,Z1,Z,A1,TT,PP)
      *** CALL SUBROUTINE HGTAGL TO DETERMINE HEIGHT (AGL) OF
      *** POSITIVE AREA.
      CALL HGTAGL(D,TT,A,PP,Y)
      RETURN
      END
      SUBROUTINE LCLCCL(T3,D1,A,B,Z4,D,Z3,E,Z2,F,Z1,G,T1,P1,BB,T,P)
      N = 0
      BB = B
      DD = D1
   10 T = T3-(0.212+0.001571*T3-0.000436*BB)*DD
      P = A*((T+273.16)/(BB+273.16))**3.5
      IF(N) 20,20,30
   20 T1 = T  ! TEMPERATURE AT LCL
      P1 = P  ! PRESSURE AT LCL
      *** INCREMENT SURFACE T AND SURFACE DEW POINT SPREAD BY 1 FOR
      *** ITERATION
   30 BB = BB + 1.
      DD = DD + 1.
      *** CHECK PRESS TO DETERMINE WHICH LAPSE RATE TO USE.
      IF(P-850.) 40,40,70
   40 IF(P-700.) 50,50,80
   50 IF(P-500.) 60,60,90
   60 GO TO 100
```

```
 70 X = D - Z4 * (P-850.)
    GO TO 110
 80 X = E - Z3 * (P-700.)
    GO TO 110
 90 X = F - Z2 * (P-500.)
    GO TO 110
100 X = G - Z1 * (P-300.)
110 IF(T-X) 120,130,130
120 N = N + 1
    GO TO 10
130 CONTINUE
    RETURN
    END
    SUBROUTINE PAREA(T,P,Z3,Z2,Z1,Z,A1,TT,PP)
    *** INITIALIZE VARIABLES
    X = T
    A1 = 0.
    TT = T
    PP = P
10  E4 = 6.11 * 10**((7.567*TT) / (239.7+TT))  ! SAT VAPOR PRES
    Z0 = 2428.45 + (303. - (TT + 273.16)) * (204.60) / 80.  ! LHC
    *** MOIST ADIABATIC FORMULA - NEXT 3 STATEMENTS
    ZM1 = PP + (0.622) * Z0 * E4/((0.287) * (TT + 273.16))
    ZM2 = PP + (0.622)*(E4*Z0**2.)/((1.003)*(0.461)*(TT+273.16)**2.)
    ZM3 = (0.287) * (TT+273.16) / (1.003*PP)
    ZM4 = ZM3 * ZM1 / ZM2
    TT = (-ZM4) * 10. + TT   ! NEW T (ADIABATIC EQUATION)
    PP = PP - 10.  ! DECREASE PRESS BY 10 MILLIBARS
    *** CHECK P TO DETERMINE WHICH ENVIRONMENTAL LAPSE RATE TO USE.
    IF(PP-700.) 20,20,50
 20 IF(PP-500.) 30,30,60
 30 IF(PP-300.) 40,40,70
 40 GO TO 80
 50 X = Z3 * 10. + X
    GO TO 90
 60 X = Z2 * (600./PP) * 10. + X  ! USE (600./PP) TO NORMALIZE DT/DP
    IKK = 1
    GO TO 90
 70 X = Z1 * (400./PP) * 10. + X  ! USE (400./PP) TO NORMALIZE DT/DP.
    IKK = 2
    GO TO 90
 80 X = Z * (250./PP) * 10. + X   ! USE (250./PP) TO NORMALIZE DT/DP.
    IKK = 3
 90 A2 = (TT-X) * (0.287) * (ALOG((PP+10.)/PP))  ! COMPUTE POSTIVE AREA.
    IF(PP.LE.250.) GO TO 110  ! CUT OFF AT 250MB
    IF(A2) 110,100,100  ! IF A IS NEGATIVE, TOP OF POSITIVE AREA REACHED.
100 A1 = A2 + A1   ! ACCUMULATE POSITIVE AREA (J/G)
    GO TO 10
110 CONTINUE
    RETURN
    END
    SUBROUTINE HGTAGL(D,TT,A,PP,Y)
    *** SUBROUTINE TO DETERMINE THE HEIGHT OF POSITIVE AREA.
```

```
 T8 = (D+TT)/2.+273.16
 Y  = (ALOG(A/PP)*T8*(287.04)/9.8)*(3.28)
 RETURN
 END
 SUBROUTINE TOTALS
 *** WE CALCULATE THE CROSS TOTALS(CT), VERTICAL TOTALS(VT), AND
 *** TOTAL TOTALS (TT).  WE USE THE 700 AND 500 MILLIBAR LEVELS.
 INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
 REAL KI,KTT,MISO,MIS1
 COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
+HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
 COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
+PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HITO,MISO,CI,ALI,UI,
+RSLTA,AHIT1,AMIS1,AHITO,AMISO,PAJG,TOPOS,TC,PCCL,TCCL,UII
 *** CT = 850MB DEW POINT TEMPERATURE - 500MB TEMPERATURE
 CT = DPMP(3) - TMP(4)
 *** VT = 850MB TEMPERATURE - 500MB TEMPERATURE
 VT =  TMP(3) - TMP(4)
 *** TOTAL TOTALS = (850MB TEMP + 850MB DEWPT)-(2*500MB TEMP)
 TT = (TMP(3) + DPMP(3)) - 2*TMP(4)
 *** COMPUTE K-INDEX
 KI   = (TMP(2) - TMP(4)) + DPMP(2) - DDMP(3)
 KTT  = TT + KI
 RETURN
 END
 SUBROUTINE POTEMP
 *** CALCULATE CONVECTIVE INSTABILITY FROM EQUIVALENT POTENTIAL
 *** TEMPERATURE
 REAL KI,KTT,MR,MISO,MIS1
 INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
 COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
+HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
 COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
+PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HITO,MISO,CI,ALI,UI,
+RSLTA,AHIT1,AMIS1,AHITO,AMISO,PAJG,TOPOS,TC,PCCL,TCCL,UII
 *** COMPUTE CONVECTIVE INSTABILITY.
 CI = EQMP(4) - (EQMP(2) + EQMP(3))/2.
 RETURN
 END
 SUBROUTINE RESULT
 *** SETUP THE REGRESSION ALGORITHMS USING THE MOST SIGNIFICANT
 ***  PARAMETERS.
 INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
 REAL KI,KTT,MISO,MIS1
 CHARACTER*9 FILN,FILEN,DATES
 CHARACTER*8 TIMS
 CHARACTER*4 SITE
 COMMON /READ1/ PPL(100),TTE(100),TTD(100),DDD(100),HHT(100),
+WD(100),WS(100)
 COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
+HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
 COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
+PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HITO,MISO,CI,ALI,UI,
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     +RSLTA,AHIT1,AMIS1,AHITO,AMISO,PAJG,TOPOS,TC,PCCL,TCCL,UII
      COMMON /TIMES/ ISOND,IYR,IHR,MDAYS,IPROC,IMON
      COMMON /CHARA/ FILN,SITE,FILEN,DATES,TIMS
      COMMON /MISC/ ISIG,IEQU,IEQN,IMISS
      IF(IPROC.EQ.1) THEN
10      WRITE(6,*)'ENTER THE FIRST EQUATION NUMBER'
        READ(6,*) IEQU
      ENDIF
      ISKL = 1
      IF(IEQU.EQ.16) THEN
        CALL EQN16(ISKL)
      ELSEIF(IEQU.EQ.27) THEN
        CALL EQN27(ISKL)
      ELSEIF(IEQU.EQ.30) THEN
        CALL EQN30(ISKL)
      ELSEIF(IEQU.EQ.31) THEN
        CALL EQN31(ISKL)
      ELSEIF(IEQU.EQ.35) THEN
        CALL EQN35(ISKL)
      ELSEIF(IEQU.EQ.37) THEN
        CALL EQN37(ISKL)
      ELSEIF(IEQU.EQ.41) THEN
        CALL EQN41(ISKL)
      ELSE
        WRITE(6,*)'NO SUCH EQUATION'
        GO TO 10
      ENDIF
      CALL SKILLM
      IF(IPROC.EQ.1) THEN
20      WRITE(6,*)'ENTER SECOND EQUATION NUMBER'
        READ(6,*) IEQN
      ENDIF
      ISKL = 2
      IF(IEQN.EQ.11) THEN
        CALL EQN11(ISKL)
      ELSEIF(IEQN.EQ.21) THEN
        CALL EQN21(ISKL)
      ELSEIF(IEQN.EQ.33) THEN
        CALL EQN33(ISKL)
      ELSEIF(IEQN.EQ.34) THEN
        CALL EQN34(ISKL)
      ELSEIF(IEQN.EQ.36) THEN
        CALL EQN36(ISKL)
      ELSEIF(IEQN.EQ.43) THEN
        CALL EQN43(ISKL)
      ELSE
        WRITE(6,*)'NO SUCH EQUATION'
        GO TO 20
      ENDIF
      CALL SKILLA
      *** CHANGE TOPOS TO FIT IN A 5 WIDTH FIELD.
      *** ADD A " ZERO ' AFTER THE LAST DIGET IF NECESSARY.
      TOPOS = TOPOS/10.
```

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*** COMPUTE UPPER LEVEL INSTABILITY INDEX
IF(DDD(3).GE.25. .AND. UI.LE.2.) THEN
  UII = 7.
ELSEIF(DDD(3).GE.20. .AND. UI.LE.3.)THEN
  UII = 6.
ELSEIF(DDD(3).GE.15. .AND. UI.LE.4.) THEN
  UII = 5.
ELSEIF(DDD(3).GE.10. .AND. UI.LE.5.) THEN
  UII = 4.
ELSEIF(DDD(3).GE.5. .AND. UI.LE.6.) THEN
  UII = 3.
ELSEIF(DDD(3).GE.0. .AND. UI.LE.7.) THEN
  UII = 2.
ELSE
  UII = 1.
ENDIF
IF(IPROC.EQ.1) THEN
  OPEN(UNIT=4,FILE=FILEN,STATUS='UNKNOWN',IOSTAT=IOS)
ENDIF
IF(IOS.GT.0) THEN
  WRITE(6,30) FILEN,IOS
30  FORMAT(2X,'ERROR OPENING FILE: ',A9,4X,'IOSTAT= ',I3,
 +  ' PROGRAM WILL NOW STOP ')
  CALL EXIT
ENDIF
*** SETUP SEVERE WEATHER PARAMETERS FOR DISPLAY
*** OUTPUT FORMAT FOLLOWS:
WRITE(UNIT=4,FMT=40,IOSTAT=IOS,ERR=50)
+WI,KI,TT,KTT,PW,RH5AV,PLM(1),TMP(1),DPMP(1),DDMP(1),TMP(2),
+DPMP(2),DDMP(2),TMP(3),DPMP(3),DDMP(3),TMP(4),DPMP(4),DDMP(4),
+HTMP(2),HTMP(3),HTMP(4),THK,V(4),U(4),V(3),U(3),UII,CB,PRECI,
+CBPRE,TSTM,TSPRE,VBAR,UBAR,CI,RH4AV,UI,ALI,PAJG,TC,TOPOS,
+PCCL,TCCL,TMP(5),DPMP(5),DDMP(5),RSLTM,HIT1,MIS1,HIT0,MIS0,
+RSLTA,AHIT1,AMIS1,AHIT0,AMIS0
40 FORMAT(4F5.1,F5.2,F5.1,F5.0,8F5.1,/,4F5.1,4F5.0,4F5.1,F5.0,/,
+5I5,3F5.1,1F5.2,F5.1,F5.2,F5.3,F5.1,2F5.0,/,4F5.1,F5.3,
+4F5.0,F5.3,4F5.0)
GO TO 60
50 CLOSE(UNIT=4)
60 CONTINUE
RETURN
END
SUBROUTINE EQN11(ISKL)
*** SETUP THE REGRESSION OUTPUT USING THE MOST SIGNIFICANT
*** PARAMETERS.
INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
REAL KI,KTT,MIS0,MIS1
COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
+HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
+PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HIT0,MIS0,CI,ALI,UI,
+RSLTA,AHIT1,AMIS1,AHIT0,AMIS0,PAJG,TOPOS,TC,PCCL,TCCL,UII
RSLT = 0.96455 + 0.00625 * KI + 0.84450 * PW +
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+        (-0.01924) * DDMP(1) + 0.03164 * TMP(2) +
+        (-0.05015) * TMP(4) + (-0.0012739) * HTMP(2) +
+        0.00226 * V(4) + (-0.00259) * U(4) + (-0.00657)
+        * V(3) + 0.00806 * VBAR + 0.01546 * CI +
+        0.00040541 * RH4AV + 0.00182 * ALI
 IF(ISKL.EQ.1) THEN
   RSLTM = RSLT
 ELSE
   RSLTA = RSLT
 ENDIF
 RETURN
 END
 SUBROUTINE EQN16(ISKL)
 *** SETUP THE REGRESSION OUTPUT USING THE MOST SIGNIFICANT
 *** PARAMETERS.
 INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
 REAL KI,KTT,MISO,MIS1
 COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
+HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
 COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
+PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HITO,MISO,CI,ALI,UI,
+RSLTA,AHIT1,AMIS1,AHITO,AMISO,PAJG,TOPOS,TC,PCCL,TCCL,UII
 RSLT = 2.45522 + 0.00603 * TT + 0.45404 * PW + 0.01290 *
+        TMP(1) + (-0.01410) * DPMP(1) + (-0.02107) * DPMP(2)
+        + (-0.00176) * THK + 0.00393 * V(4) + (-0.00778) *
+        U(4) + 0.01067 * RH4AV + 0.00489 * UI + (-0.00481)
+        * ALI + 0.14671 * PAJG
 IF(ISKL.EQ.1) THEN
   RSLTM = RSLT
 ELSE
   RSLTA = RSLT
 ENDIF
 RETURN
 END
 SUBROUTINE EQN21(ISKL)
 *** SETUP THE REGRESSION OUTPUT USING THE MOST SIGNIFICANT
 *** PARAMETERS.
 INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
 REAL KI,KTT,MISO,MIS1
 COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
+HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
 COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
+PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HITO,MISO,CI,ALI,UI,
+RSLTA,AHIT1,AMIS1,AHITO,AMISO,PAJG,TOPOS,TC,PCCL,TCCL,UII
 RSLT = 0.02860 + 0.01156 * KTT + (-0.00854) * DDMP(4) +
+        0.00641 * V(4) + 0.00917 * U(3) + 0.00547 *
+        DPMP(5)
 IF(ISKL.EQ.1) THEN
   RSLTM = RSLT
 ELSE
   RSLTA = RSLT
 ENDIF
 RETURN
```

```
      END
      SUBROUTINE EQN27(ISKL)
      *** SETUP THE REGRESSION OUTPUT USING THE MOST SIGNIFICANT
      *** PARAMETERS.
      INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
      REAL KI,KTT,MISO,MIS1
      COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
     +HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
      COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
     +PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HITO,MISO,CI,ALI,UI,
     +RSLTA,AHIT1,AMIS1,AHITO,AMISO,PAJG,TOPOS,TC,PCCL,TCCL,UII
      RSLT =  1.90590 + 0.01203 * TMP(1) + (-0.00754) * DDMP(3) +
     +        (-0.0012275) * HTMP(2) + 0.00169 * V(4) + (-0.00469)
     +        * U(4) + 0.02778 * UII + 0.00398 * VBAR + 0.01025 *
     +        RH4AV + (-0.01017) * ALI + 0.11552 * PAJG +
     +        (-0.00892) * DDMP(5)
      IF(ISKL.EQ.1) THEN
        RSLTM = RSLT
      ELSE
        RSLTA = RSLT
      ENDIF
      RETURN
      END
      SUBROUTINE EQN30(ISKL)
      *** SETUP THE REGRESSION OUTPUT USING THE MOST SIGNIFICANT
      *** PARAMETERS.
      INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
      REAL KI,KTT,MISO,MIS1
      COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
     +HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
      COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
     +PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HITO,MISO,CI,ALI,UI,
     +RSLTA,AHIT1,AMIS1,AHITO,AMISO,PAJG,TOPOS,TC,PCCL,TCCL,UII
      RSLT =  0.02391 + 0.00764 * DDMP(1) + 0.00338 * V(4) +
     +        (-0.0024210) * U(4) + 0.00352 * V(3) + 0.02998 *
     +        UII + 0.01160 * RH4AV + (-0.02602) * ALI
      IF(ISKL.EQ.1) THEN
        RSLTM = RSLT
      ELSE
        RSLTA = RSLT
      ENDIF
      RETURN
      END
      SUBROUTINE EQN31(ISKL)
      *** SETUP THE REGRESSION OUTPUT USING THE MOST SIGNIFICANT
      *** PARAMETERS.
      INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
      REAL KI,KTT,MISO,MIS1
      COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
     +HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
      COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
     +PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HITO,MISO,CI,ALI,UI,
     +RSLTA,AHIT1,AMIS1,AHITO,AMISO,PAJG,TOPOS,TC,PCCL,TCCL,UII
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      RSLT =  (-0.05762) + 0.00428 * KTT + 0.00911 * DDMP(1) +
     +        0.00362 * V(4) + (-0.00220) * U(4) + 0.00290 * V(3)
     +        + 0.02408 * UII + 0.00946 * RH4AV + (-0.00339) *
     +        UI + (-0.01893) * ALI
      IF(ISKL.EQ.1) THEN
        RSLTM = RSLT
      ELSE
        RSLTA = RSLT
      ENDIF
      RETURN
      END
      SUBROUTINE EQN33(ISKL)
      *** SETUP THE REGRESSION OUTPUT USING THE MOST SIGNIFICANT
      *** PARAMETERS.
      INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
      REAL KI,KTT,MISO,MIS1
      COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
     +HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
      COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
     +PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HITO,MISO,CI,ALI,UI,
     +RSLTA,AHIT1,AMIS1,AHITO,AMISO,PAJG,TOPOS,TC,PCCL,TCCL,UII
      RSLT =  2.97187 + 0.01491 * KI + (-0.01499) * DDMP(1) +
     +        0.01544 * TMP(2) + (-0.0020601) * HTMP(2) +
     +        (-0.00574) * V(3) + 0.00599 * VBAR + 0.01856 * CI
     +        + 0.00964 * RH4AV + (-0.02084) * ALI
      IF(ISKL.EQ.1) THEN
        RSLTM = RSLT
      ELSE
        RSLTA = RSLT
      ENDIF
      RETURN
      END
      SUBROUTINE EQN34(ISKL)
      *** SETUP THE REGRESSION OUTPUT USING THE MOST SIGNIFICANT
      *** PARAMETERS.
      INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
      REAL KI,KTT,MISO,MIS1
      COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
     +HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
      COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
     +PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HITO,MISO,CI,ALI,UI,
     +RSLTA,AHIT1,AMIS1,AHITO,AMISO,PAJG,TOPOS,TC,PCCL,TCCL,UII
      RSLT =  (-0.41608) + (-0.02609) * KI + 0.02026 * KTT +
     +        0.57186 * PW + (-0.02205) * DDMP(1) + 0.05166 *
     +        TMP(2) + (-0.05166) * TMP(4) + 0.01171 * DDMP(4)
     +        + (-0.00099998) * HTMP(2) + 0.00244 * V(4) +
     +        (-0.00164) * U(4) + (-0.00528) * V(3) + 0.00837 *
     +        VBAR + 0.02746 * CI + 0.00947 * RH4AV
      IF(ISKL.EQ.1) THEN
        RSLTM = RSLT
      ELSE
        RSLTA = RSLT
      ENDIF
```

14. Stipanuk, G.S. 1973. Algorithms for Generating a Skew-T, Log P Diagram and Computing Selected Meteorological Quantities, Atmospheric Sciences Laboratory, U. S. Army Electronics Command, White Sands Missile Range, New Mexico 88002, 33 pp.

15. George, J.J. 1960. Weather Forecasting for Aeronautics, Academic Press, 673 pp.

16. Miller, R.C., 1972. Notes on Analysis and Severe Storm Forecasting Procedures of the Air Force Global Weather Center, Air Weather Service Tech. Rep. 200 (Rev.), 102 pp. (AD-744042).

17. Scientific Services 1976. Gusty Surface Winds and High Level Thunderstorms, Western Region Technical Attachment, 76-14, Western Region, NWS, Salt Lake City, UT.

18. Scientific Services 1984. Severe Thunderstorms - - Western Style, Western Region Technical Attachment, 84-15, Part I, Western Region NWS, Salt Lake City, UT, 6 pp.

19. Neuberger, H., 1957. Introduction to Physical Meteorology, Pennsylvania State University Press, 271 pp. (see p. 146)

20. Neter, John and William Wasserman, 1974. Applied Linear Statistical Models, Richard D. Irwin, Inc., Homewood, Ill 60430, 842 pp.

21. Dixon, W.J. and Robert Jennrich 1983. BMDP2R Stepwise Regression, BMDP Statistical Software, University of California Press, Los Angeles, CA, pp. 251-263.

22. Panofsky, H.A. and G.W. Brier 1965. Some Applications of Statistics to Meteorology, The Pennsylvania State University, University Park, 224 pp.

23. Donaldson, R.J., Jr., R.M. Dyer and M.J. Kraus, 1975. An Objective Evaluator of Techniques for Predicting Severe Weather Events, Preprints Ninth Conf. Severe Local Storms, Norman, Amer. Meteor. Soc., 321-326.

24. Brier, G.W., 1950. Verification of Forecasts Expressed in Terms of Probability, Mon. Wea. Rev., 78, 1-3.

25. Neter, John, William Wasserman, and Michael H. Kutner, 1985. Applied Linear Statistical Models, Second Edition, Richard D. Irwin, Inc., Homewood Ill., 60430, 1127 pp.

26. Hogg, Robert V., 1979. Statistical Robustness: One View of Its Use in Application Today, The American Statistician 33, 108-115.

APPENDIX I. REFERENCES

1. Stewart, William H., et al, 1968. Report of the Interagency Ad Hoc Advisory Committee for Review of Testing Safety at Dugway Proving Ground, Department of the Army, Washington, D.C., 20310, 39 pp.

2. Cherna, E. 1984. An Objective Technique for Delineation and Extrapolation of Thunderstorms from the GOES Satellite Data, J. Geophys. Res., D, Paper 4D1510.

3. Glahn, Harry R. and Dale A. Lowry, 1972. The Use of Model Output Statistics (MOS) in Objective Weather Forecasting, J. Appl. Meteor, 11, 1203-1211.

4. Klein, William H., 1976. The AFOS Program and Future Forecast Applications, Mon. Wea. Rev., 104, 1494-1503.

5. Reap, Ronald M. and Donald S. Foster, 1979. Automated 12-36 Hour Probability Forecasts of Thunderstorms and Severe Local Storms, J. Appl. Meteor., 18, 1494-1503.

6. Scientific Services 1984. The Regional Analysis and Forecast System (RAFS) Under Development at NMC, Western Region Technical Attachment, 84-37, Western Region NWS, Salt Lake City, UT, 6 pp.

7. Maier, M.W., et al, 1983. Locating Cloud-to-Ground Lightning with Wideband Magnetic Direction Finders, Fifth Symposium on Meteorological Observations and Instrumentation, Toronto, Ont., Canada, AMS, Boston, Mass., 497-504.

8. Scientific Services, 1974. Summer Radar Detection Chart, Western Region Technical Attachment, 74-10, Western Region NWS, Salt Lake City, UT, 4 pp.

9. Pearson, Allen, 1976. Operational Forecasting and Warning of Severe Local Storms, Bull. Amer. Meteor. Soc., 57, 420-423.

10. Anthes, R. A., Harold D. Orville, and David J. Raymond, 1982. Mathematical Modelling of Convection, Thunderstorms: A Social, Scientific and Technological Documentary, Vol. 2. Thunderstorm Morphology and Dynamics, US Dept. of Commerce, NOAA, ERL., pp 495-572. (see page 544)

11. Garrett, A. J., 1983. Drainage Flow Prediction with a One-Dimensional Model Including Canopy, Soil and Radiation Parametization, J. Climate Appl. Meteor., 22, 79-91.

12. Henz, John F., 1972. An Operational Technique of Forecasting Thunderstorms Along the Lee Slopes of a Mountain Range, J. Appl. Meteor., 11, 1284-1292.

13. Randerson, Darryl, 1977. Determining the Relative Frequency of Occurence of Local Cumulonimbus Activity through Discriminant Analysis, Mon. Wea. Rev., 105, 709-712.

*   multiplication symbol

LFM	limited area fine mesh model from which prognostic maps are prepared
LINWS	NWS lifting index (Table 2), ^{o}C
LIW	simplified lifting index (Table 2), ^{o}C
MJS	May-June 14 and September
MST	mountain standard time
MOS	model output statistics, maximum and minimum temperature objective forecasts prepared using the LFM and trajectory numerical models, plus the appropriate regression equation for the station involved
NGM	nested grid primitive equation 12 layer model
NMC	Numerical Modelling Center, NWS
PRECI	trace or more of precipitation, inches
POSAR	positive area (Table 2), joules/gm
PW	precipitable water surface to 500 mb, inches
r	correlation coefficient
R	the solution for any of the regression equations listed in Appendix D
RAOB	radiosonde
RH4	average relative humidity, surface to 400 mb, percent
RH5	average relative hunidity, surface to 500 mb, percent
S.S.	skill score, page 9 equation (5)
T85, -70, -50, -40,	temperature at 850, 700, 500, 400 mb, ^{o}C
TOT	total totals index, page 4 equation (2), ^{o}C
TSPRE	thunder and precipitation at the same time
TSUR	surface temperature, ^{o}C
TSTM	thunder heard at the station
UI	high level stability indicator, page 6 equation (4), ^{o}C
UII	a combination of UI and 700 mb dewpoint depression (Table 2)
WSR57	NWS 10 cm radar

APPENDIX H. LIST OF SYMBOLS AND ABBREVIATIONS

AFOS Automatic Field Operating System, NWS

ALDS Automatic Lightning detection system

ARTC Air Route Traffic Control

BMDP2R University of California Los Angeles stepwise multiple regression program

BSS Brier skill score, page 12 equation (7)

CB cumulonibus cloud

CBPRE CB or precipitation

CCL convective condensation level, intersection of a sounding curve with the saturation mixing ratio line corresponding to the average mixing ratio in the surface layer, m

CDSI Computer Data Systems, Inc.

CONVI convective instability, page 4 equation (3), ^{o}C

DEP85, -70, -50, -40, dewpoint depression at 850, 700, 500, 400 mb, ^{o}C

DPG Dugway Proving Ground, UT

E.E. estimated error, page 11 equation (6)

F.A.A. Federal Aviation Administration

GMT Greenwich meridian time

GOES Geostationary Environmental Operating System used to produce sattelite pictures of clouds

H85, -70, -50, heights at 850, 700, 500 mb, m

H7085 thickness from 700 to 850 mb

JJA June 15 - August 31

K K index, page 4 equation (1)

KSLC identification letters for the Salt Lake City airport weather station

LA Los Angeles

LCL lifting condensation level, the level at which a parcel of moist air lifted dry adiabatically becomes saturated, m

```
 0.3 -  0.70
-1.0 -  0.70
A
ENTER 1 (FIRST EQUATION); 2 (SECOND EQUATION)
2
```

Program runs and produces a frequency table for equation 44 with ranges as given above.

A program BRSLT produces a file of the five predictands and the sixteen predictors:

```
$ RUN BRSLT
ENTER NUMBER OF DAYS
651
ENTER INPUT FILE NAME
WMJS7078M
ENTER OUTPUT FILE NAME
RMJSLI78M
```

Program runs and produces the output in (4I5,16F5) FORTRAN format:

I_1, I_2, I_3, I_4, I_5,LINWS,PW,RH4,POSAR,H85,U5,V5,V7,VSUR,SURT,SURDEP,

TD70,DEP40,KI,TT,UII.

Two programs, STATTS AND STATCBP produce frequency tables for TSTM or CBPRE and any one of the sixteen predictors:

```
$ RUN STATTS
HOW MANY VALUES WILL BE PROCESSED?, MAX=2000
651
ENTER FILE NAME USED TO BUILD INPUT FILE
WMJS7078M
ENTER INPUT FILE NAME
RMJSLI78M
ENTER OUTPUT FILE NAME
SMJSPW78M
ENTER POINT VALUES OR -99.9 TO STOP
0.15
0.50
1.00
2.00
A
ENTER ONE PARAMETER
LI(LINWS),PW,RH4,PA(POSAR),H85,U5,V5,V7,VBAR(VSUR),TMPS(SURT),
DEPS(SURDEP),DPT7(TD70),DEP4(DEP40),KI,TT,UII.
PW
```

Program runs and outputs a frequency table relating PW to the occurence of TSTM similar to Table C.49.

Fourth: Forecast no, observed yes (0,0,0,1).

The second auxiliary program (STATC2) produces a frequency table like B.2:

```
$ RUN STATC2
HOW MANY VALUES WILL BE PROCESSED?  MAX = 2000.
651
ENTER FILE NAME USED TO BUILD INPUT FILE
WMJS7078M
ENTER INPUT FILE NAME
R37447078
ENTER OUTPUT FILE NAME
S447078M
ENTER MONTH(S)/PERIOD OF DATA
MJS
ENTER YEAR(S) OF DATA, EX:70-78
70-78
ENTER OUTPUT FILE NAME
S37447078
ENTER 1 (FIRST EQUATION); ENTER 2 (SECOND EQUATION)
2
```

Program runs and produces Table B.3 for equation 44 for one tenth and two-tenth R class intervals.

Program STATC3 also produces a frequency table where the user inputs the R values for up to 13 classes:

```
$ RUN STATC3
HOW MANY VALUES WILL BE PROCESSED?  MAX = 2000.
651
ENTER FILE NAME USED TO BUILD INPUT FILE
WMJS7078M
ENTER INPUT FILE NAME
R37447078
ENTER OUTPUT FILE NAME
S447078M
ENTER MONTH(S)/PERIOD OF DATA
MJS
ENTER YEAR(S) OF DATA, EX: 70-78
70-78
ENTER POINT VALUES OR -99.9 TO STOP
-1.
-0.5
 0.0
 0.3
 0.7
-99.9
ENTER RANGE VALUES PLUS TOTAL RANGE OR "A" TO STOP
-1.0 - -0.6
-0.5 - -0.01
 0.0 -  0.29
```

APPENDIX G. AUXILIARY PROGRAMS.

Several programs were written by CDSI to speed up processing and to perform specific tasks. All the programs are user-friendly. The first, B77, is a program which produces contingency tables and result data files using the WMJS or WJJA files produced by the program BRNCR for input. This program does not calculate predictor values and produces contingency tables and result data files faster than BRNCR. The menu for B77 follows:

```
$ RUN B77
ENTER NUMBER OF DAYS
651
ENTER MONTH(S),EX:JUN
MJS
ENTER YEARS OF DATA, EX:70-78.
70-78
ENTER TIME OF DATA, HOURS
12
ENTER SITE LOCATION, EX:KSLC
KSLC
ENTER INPUT FILE NAME, EX: WJJA7078M
WMJS7078M
ENTER OUTPUT FILE NAME, CT
C37447078
ENTER OUTPUT FILE NAME, RESULT.DAT
R37447078
ENTER VERIFICATION PARAMETER, EX: CBPRE
TSTM
ENTER FIRST EQUATION NUMBER
37
ENTER ANY COMPARISON VALUE, EX: 0.5 OR 0.35
0.6
ENTER SECOND EQUATION NUMBER
44
ENTER ANY COMPARISON VALUE, EX:0.5 OR 0.35
0.35
```

End of entries. Program B77 runs and produces a contingency table for the two equations like Table B.1 and a RESULT.DAT file named R37447078.DAT, as follows:

$0.X_1X_1X_1$----0----0----1----0----$0.X_2X_2X_2$----0----0----1----0----------37---44

where the format is (F5.3,4I5,4X,F5.3,4I5,6X,2I5). The first entry, $0.X_1X_1X_1$ is the solution for the first equation (37) for the first of the 651 days. The entry $0.X_2X_2X_2$ is the solution for the second equation (44) for the same day. The zeros and ones are verification figures for the given day and equation. The meaning of these figures follows:

First from left to right: Forecast yes, observed yes (1,0,0,0),
Second: Forecast yes, observed no (0,1,0,0),
Third: Forecast no, observed no (0,0,1,0),

```
      DD = ((TOY*TFY)+(TON*TFN))/TYN
      IF(DD.EQ.TYN) GO TO 20
      SS = ((THIT1+THIT0)-DD)/(TYN-DD)
      GO TO 30
20    WRITE(6,*)'SECOND SKILL SCORE UNAVAILABLE'
30    CONTINUE
      COR = THIT/FLOAT(IPROC)
      CORR = COR * 100.
      *** DISPLAY CONTINGENCY TABLE
      WRITE(UNIT=3,FMT=40,IOSTAT=IOS,ERR=50)MON(IMON),IYR,SITE,
   +  IEQN,IHR,THIT1,TMIS1,TFY,TMIS0,THIT0,TFN,TOY,TON,TYN,
   +  DD,SS,CORR
 40   FORMAT(71('-'),/,
   +  26X,'CONTINGENCY TABLE',/,71('-'),/,
   +  4X,'PERIOD: ',A3,13X,'YEAR(S): 19',I2,8X,
   +  'LOCATION: ',A4,/,71('-'),/,4X,'SECOND EQUATION: ',I3,
   +  25X,'TIME: ',I4,' Z',/,71('-'),/,37X,'OBSERVED',//,
   +  10X,'                 YES            NO          TOTAL',//,
   +  10X,' F       YES',4X,3(F5.0,8X),//,10X,' C',/,
   +  10X,'          NO',4X,3(F5.0,8X),/,10X,' S',//,
   +  10X,' T    TOTAL',4X,3(F5.0,8X),//,71('-'),/,
   +  4X,'D: 'F5.1,15X,'SS: ',F5.3,14X,'CORRECT: ',F5.1,' %',/,
   +  71('-'))
    GO TO 70
 50 WRITE(6,60) IOS
 60 FORMAT(2X,'ERROR WRITTING TO FILE: CT.DAT, IOSTAT = ',I4)
 70 CLOSE(UNIT=3)
    ENDIF
    RETURN
    END
```

```
      CHARACTER*4 SITE
      CHARACTER*3 MON(12)
      COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
     +PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HIT0,MIS0,CI,ALI,UI,
     +RSLTA,AHIT1,AMIS1,AHIT0,AMIS0,PAJG,TOPOS,TC,PCCL,TCCL,UII
      COMMON /TIMES/ ISOND,IYR,IHR,MDAYS,IPROC,IMON
      COMMON /CHARA/ FILN,SITE,FILEN,DATES,TIMS
      COMMON /MISC/ ISIG,IEQU,IEQN,IMISS
      DATA MON/'JAN','FEB','MAR','APR','MAY','JUN',
     +         'JUL','AUG','SEP','OCT','NOV','DEC'/
C***IF LAST RADIOSONDE WAS BAD GO CALCULATE SKILL SCORE.
      IF(IMISS.EQ.1) GO TO 10
      IF(IPROC.EQ.1) THEN
        THIT1 = 0.
        THIT0 = 0.
        TMIS1 = 0.
        TMIS0 = 0.
        THIT  = 0.
        TMIS  = 0.
      ENDIF
      AHIT1 = 0.0
      AMIS1 = 0.0
      AHIT0 = 0.0
      AMIS0 = 0.0
      IF(RSLTA.GE.0.5) THEN
        IF(CBPRE.EQ.1) THEN
          AHIT1 = 1.
        ELSE
          AMIS1 = 1.
        ENDIF
      ELSE
        IF(CBPRE.EQ.0) THEN
          AHIT0 = 1.
        ELSE
          AMIS0 = 1.
        ENDIF
      ENDIF
      THIT1 = THIT1 + AHIT1
      THIT0 = THIT0 + AHIT0
      TMIS1 = TMIS1 + AMIS1
      TMIS0 = TMIS0 + AMIS0
      TFY = THIT1 + TMIS1
      TFN = TMIS0 + THIT0
      TOY = THIT1 + TMIS0
      TON = TMIS1 + THIT0
      T1  = TOY + TON
      T2  = TFY + TFN
      IF(T1.NE.T2) GO TO 20
      TYN = (T1+T2)/2.
      THIT  = THIT  + AHIT1 + AHIT0
      TMIS  = TMIS  + AMIS1 + AMIS0
   10 IF(TYN.EQ.0.0 .OR. IPROC.EQ.0) GO TO 20
      IF((IPROC+MDAYS).EQ.ISOND) THEN
```

```
      T1  = TOY + TON
      T2  = TFY + TFN
      IF(T1.NE.T2) GO TO 20
      TYN = (T1+T2)/2.
      THIT  = THIT + HIT1 + HITO
      TMIS  = TMIS + MIS1 + MISO
10    IF(TYN.EQ.0.0 .OR. IPROC.EQ.0) GO TO 20
      IF((IPROC+MDAYS).EQ.ISOND) THEN
        DD = ((TOY*TFY)+(TON*TFN))/TYN
        IF(DD.EQ.TYN) GO TO 20
        SS = ((THIT1+THITO)-DD)/(TYN-DD)
        GO TO 30
20      WRITE(6,*)'FIRST SKILL SCORE UNAVAILABLE'
30      CONTINUE
        COR = THIT/FLOAT(IPROC)
        CORR = COR * 100.
        *** DISPLAY CONTINGENCY TABLE.  OPEN FILE: CT.DAT
        OPEN(UNIT=3,FILE='CT.DAT',ACCESS='APPEND',STATUS='OLD',
     +  IOSTAT=IOS)
        IF(IOS.GT.0) THEN
          WRITE(6,40)IOS
40        FORMAT(2X,'ERROR OPENING FILE: CT.DAT, IOSTAT = ',I3,
     +    'PROGRAM WILL NOW STOP')
          CALL EXIT
        ENDIF
        WRITE(UNIT=3,FMT=50,IOSTAT=IOS,ERR=60)MON(IMON),IYR,
     +  SITE,IEQU,IHR,THIT1,TMIS1,TFY,TMISO,THITO,TFN,TOY,TON,
     +  TYN,DD,SS,CORR
50      FORMAT(71('-'),/,
     +  27X,'CONTINGENCY TABLE',/,71('-'),/,
     +  4X,'PERIOD: ',A3,13X,'YEAR(S):  19',I2,8X,'LOCATION: ',
     +  A4,/,71('-'),/,4X,'FIRST EQUATION: ',I3,27X,'TIME: ',
     +  I4,' Z',/,71('-'),/,37X,'OBSERVED',//,
     +  10X,'                   YES          NO         TOTAL',//,
     +  10X,' F      YES',4X,3(F5.0,8X),//,10X,' C',/,
     +  10X,'         NO',4X,3(F5.0,8X),/,10X,' S',//,
     +  10X,' T    TOTAL',4X,3(F5.0,8X),//,71('-'),/,
     +  4X,'D: 'F5.1,15X,'SS: ',F5.3,14X,'CORRECT: ',F5.1,' %',/,
     +  71('-'))
      ENDIF
      GO TO 80
60    WRITE(6,70) IOS
70    FORMAT(2X,'ERROR WRITTING TO FILE: CT.DAT, IOSTAT: ',I4)
80    CONTINUE
      RETURN
      END
      SUBROUTINE SKILLA
      *** COMPUTE SKILL SCORES AND PERCENT CORRECT FOR A SPECIFIED
      *** PERIOD.
      INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
      REAL KI,KTT,MISO,MIS1
      CHARACTER*9 FILN,FILEN,DATES
      CHARACTER*8 TIMS
```

```
      END
      SUBROUTINE SKILLM
      *** COMPUTE SKILL SCORES AND PERCENT CORRECT OVER A SPECIFIED
      *** PERIOD.
      INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
      REAL KI,KTT,MISO,MIS1
      CHARACTER*9 FILN,FILEN,DATES
      CHARACTER*8 TIMS
      CHARACTER*4 SITE
      CHARACTER*3 MON(12)
      COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
     +PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HITO,MISO,CI,ALI,UI,
     +RSLTA,AHIT1,AMIS1,AHITO,AMISO,PAJG,TOPOS,TC,PCCL,TCCL,UII
      COMMON /TIMES/ ISOND,IYR,IHR,MDAYS,IPROC,IMON
      COMMON /CHARA/ FILN,SITE,FILEN,DATES,TIMS
      COMMON /MISC/ ISIG,IEQU,IEQN,IMISS
      DATA MON /'JAN','FEB','MAR','APR','MAY','JUN',
     +          'JUL','AUG','SEP','OCT','NOV','DEC'/
      *** IF LAST RADIOSONDE WAS BAD THEN GO CALCULATE SKILL SCORE
      IF(IMISS.EQ.1) GO TO 10
      IF(IPROC.EQ.1) THEN
        THIT1 = 0.
        THITO = 0.
        TMIS1 = 0.
        TMISO = 0.
        THIT  = 0.
        TMIS  = 0.
      ENDIF
      HIT1 = 0.0
      MIS1 = 0.0
      HITO = 0.0
      MISO = 0.0
      IF(RSLTM.GE.0.5) THEN
        IF(CBPRE.EQ.1) THEN
          HIT1 = 1.
        ELSE
          MIS1 = 1.
        ENDIF
      ELSE
        IF(CBPRE.EQ.0) THEN
          HITO = 1.
        ELSE
          MISO = 1.
        ENDIF
      ENDIF
      THIT1 = THIT1 + HIT1
      THITO = THITO + HITO
      TMIS1 = TMIS1 + MIS1
      TMISO = TMISO + MISO
      TFY = THIT1 + TMIS1
      TFN = TMISO + THITO
      TOY = THIT1 + TMISO
      TON = TMIS1 + THITO
```

```
+         0.02766 * DPMP(3) + (-0.0019722) * HTMP(2) +
+         0.00399 * V(3) + (-0.03804) * UII + (-0.00924) *
+         VBAR + (-0.02241) * UBAR + 0.26489 * PAJG +
+         (-0.02647) * DDMP(5)
      IF(ISKL.EQ.1) THEN
        RSLTM = RSLT
      ELSE
        RSLTA = RSLT
      ENDIF
      RETURN
      END
      SUBROUTINE EQN41(ISKL)
      *** SETUP THE REGRESSION OUTPUT USING THE MOST SIGNIFICANT
      *** PARAMETERS.
      INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
      REAL KI,KTT,MISO,MIS1
      COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
     +HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
      COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
     +PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HITO,MISO,CI,ALI,UI,
     +RSLTA,AHIT1,AMIS1,AHITO,AMISO,PAJG,TOPOS,TC,PCCL,TCCL,UII
      RSLT =  (-72.68358) + (-0.00727) * KI + 0.01404 * TT +
+         1.08983 * PW + 0.10479 * PLM(1) + (-0.02850) *
+         DPMP(2) + (-0.01250) * HTMP(2) + 0.00466 *
+         V(3) + (-0.00396) * U(3) + (-0.01414) * UBAR +
+         0.08288 * PAJG + (-0.02098) * DDMP(5)
      IF(ISKL.EQ.1) THEN
        RSLTM = RSLT
      ELSE
        RSLTA = RSLT
      ENDIF
      RETURN
      END
      SUBROUTINE EQN43(ISKL)
      *** SETUP THE REGRESSION OUTPUT USING THE MOST SIGNIFICANT
      *** PARAMETERS.
      INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
      REAL KI,KTT,MISO,MIS1
      COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
     +HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
      COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
     +PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HITO,MISO,CI,ALI,UI,
     +RSLTA,AHIT1,AMIS1,AHITO,AMISO,PAJG,TOPOS,TC,PCCL,TCCL,UII
      RSLT =  (-0.14220) + 0.00635 * TT + 1.19822 * PW +
+         (-0.04488) * TMP(1) + 0.03859 * DDMP(2) +
+         0.00170 * V(4) + 0.00378 * U(3) + (-0.00970) *
+         UBAR + (-0.03254) * ALI + (-0.00459) * DPMP(5)
      IF(ISKL.EQ.1) THEN
        RSLTM = RSLT
      ELSE
        RSLTA = RSLT
      ENDIF
      RETURN
```

```
      RETURN
      END
      SUBROUTINE EQN35(ISKL)
*** SETUP THE REGRESSION OUTPUT USING THE MOST SIGNIFICANT
*** PARAMETERS.
      INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
      REAL KI,KTT,MISO,MIS1
      COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
     +HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
      COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
     +PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HITO,MISO,CI,ALI,UI,
     +RSLTA,AHIT1,AMIS1,AHITO,AMISO,PAJG,TOPOS,TC,PCCL,TCCL,UII
      RSLT =  (-0.93532) + 0.02150 * TT + 0.75083 * PW +
     +        0.00798 * V(3) + (-0.00669) * U(3) + (-0.01423) *
     +        UBAR + 0.00063766 * RH4AV + 0.03353 * ALI +
     +        (-0.04178) * TMP(5) + 0.02286 * DPMP(5)
      IF(ISKL.EQ.1) THEN
        RSLTM = RSLT
      ELSE
        RSLTA = RSLT
      ENDIF
      RETURN
      END
      SUBROUTINE EQN36(ISKL)
*** SETUP THE REGRESSION OUTPUT USING THE MOST SIGNIFICANT
*** PARAMETERS.
      INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
      REAL KI,KTT,MISO,MIS1
      COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
     +HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
      COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
     +PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HITO,MISO,CI,ALI,UI,
     +RSLTA,AHIT1,AMIS1,AHITO,AMISO,PAJG,TOPOS,TC,PCCL,TCCL,UII
      RSLT =  6.49054 + 0.01434 * TT + 0.72906 * PW +
     +        (-0.0021745) * HTMP(3) + (-0.01282) * UBAR
      IF(ISKL.EQ.1) THEN
        RSLTM = RSLT
      ELSE
        RSLTA = RSLT
      ENDIF
      RETURN
      END
      SUBROUTINE EQN37(ISKL)
*** SETUP THE REGRESSION OUTPUT USING THE MOST SIGNIFICANT
*** PARAMETERS.
      INTEGER CB,PRECI,CBPRE,TSTM,TSPRE
      REAL KI,KTT,MISO,MIS1
      COMMON /MANPD/ PLM(10),TMP(10),DPMP(10),DDMP(10),RHMP(10),
     +HTMP(10),EQMP(10),WDMP(10),WSMP(10),V(5),U(5)
      COMMON /OUT1/ PW,RH5AV,RH4AV,UBAR,VBAR,WI,KI,TT,KTT,THK,CB,
     +PRECI,CBPRE,TSTM,TSPRE,RSLTM,HIT1,MIS1,HITO,MISO,CI,ALI,UI,
     +RSLTA,AHIT1,AMIS1,AHITO,AMISO,PAJG,TOPOS,TC,PCCL,TCCL,UII
      RSLT =  3.59814 + 0.52291 * PW + (-0.04876) * DPMP(2) +
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